OCTOBER 1960

Agricultural Engineering

The Journal of the American Society of Agricultural Engineers

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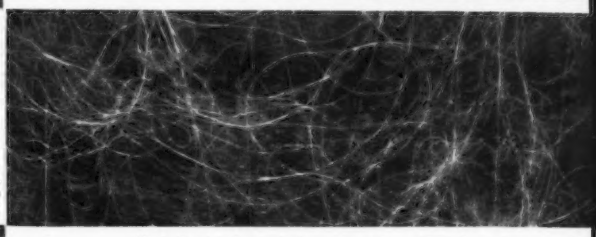
Stressed-Skin Panel Design | 686

Fiberglass Filters for Closed Tile Drains | 690



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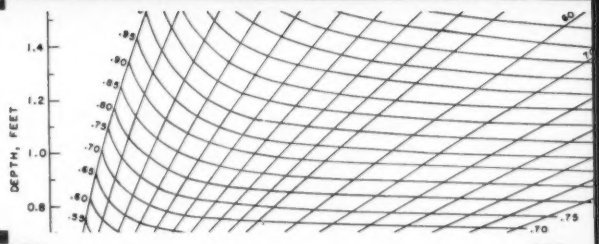

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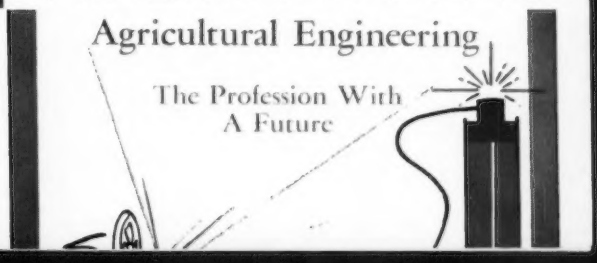

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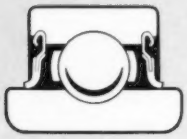
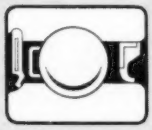


NEW LAND-RIDING SEAL (Crimped)

N/D's newest seal design. Efficient single lip, low-torque seal protects against moist or dry contaminants. Retains bearing lubricant-for-life. Recommended for farm implement discs, idler pulleys, wheels and similar applications. Available also with metal trash guards to protect seal against mechanical damage from trash windings.



NEW LAND-RIDING SEAL (Pressed) and SENTRI-SEAL

This exclusive seal combination is available in N/D's new heavy-duty conveyor ball bearings. Land-Riding seals, especially resistant to moist contaminant penetration, are available separately in N/D's bearings for hay rake tine bar, plow, hiller and coulter applications. Tandem seal arrangements are also available.

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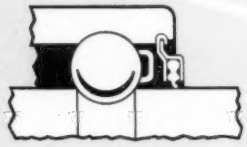
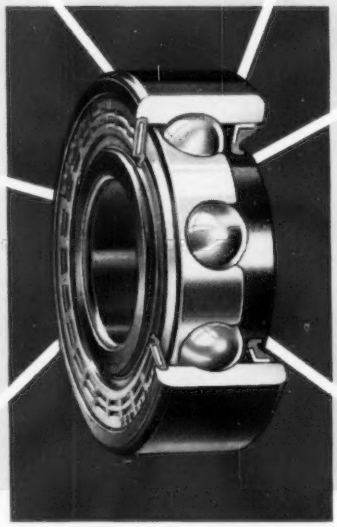
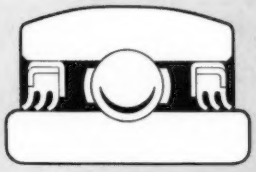
N/D's most versatile seal . . . available in most single row, non-loading groove and small double row N/D ball bearings. N/D Sentri-Seals are recommended for applications with moderate to severe contaminant conditions as found in light duty discs, idler pulleys, cam followers, implement wheels, adapter bearings and similar applications.



NEW DOUBLE "O" SEAL

N/D's most original seal design, used in fan and water pump bearings where water seepage is prime source of bearing contamination. Synthetic rubber seal rides smooth shaft O.D., offers reliable low-torque sealing and eliminates relubrication.





NEW TRIPLE LIP SEAL

N/D's most rugged seal . . . used where moist and dry contaminant conditions are most severe. Seal eliminates relubrication maintenance. It's available in N/D square and round bore ball bearings with either spherical or cylindrical O.D.'s.

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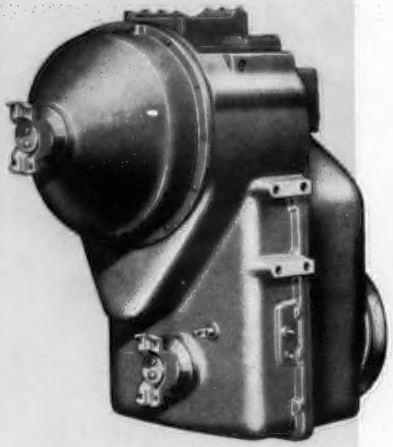
proved reliability you can build around



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- 3-to-1 torque multiplication.
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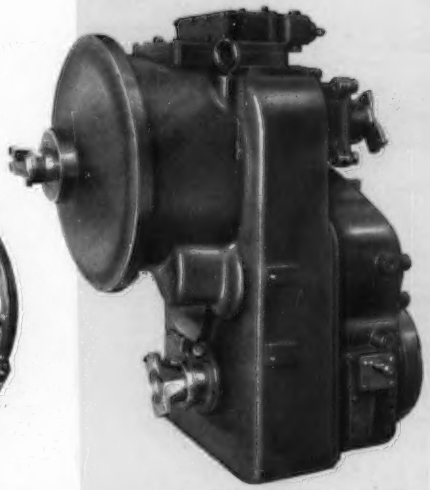

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With four speeds forward and reverse, the Hydra-Drives Power Shift Transmissions are ideally suited for vehicles which must travel in both directions during a normal work cycle.

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Agricultural Engineering

Established 1920

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Note: AGRICULTURAL ENGINEERING is regularly indexed by Engineering Index and by Agricultural Index. Volumes of AGRICULTURAL ENGINEERING, in microfilm, are available (beginning with Vol. 32, 1951), and inquiries concerning purchase should be directed to University Microfilms, 313 North First Street, Ann Arbor, Michigan.

AGRICULTURAL ENGINEERING is owned and published monthly by the American Society of Agricultural Engineers. Editorial, subscription and advertising departments are at the central office of the Society, 420 Main St., St. Joseph, Mich. (Telephone: YUkon 3-2700).

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SUBSCRIPTION PRICE: $8.00 a year, plus an extra postage charge to all countries to which the second-class postage rate does not apply; to ASAE members anywhere, $4.00 a year. Single copies (current), 80¢ each.

POST OFFICE ENTRY: Entered as second-class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921.

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OVER THE TOP

VISION to foresee a need — courage to take necessary action in spite of obstacles or doubts — determination to follow through to a successful conclusion — these mark the progress of the ASAE Career Motion Picture, "Agricultural Engineering — The Profession with a Future," which is now a reality. And always behind a successful endeavor are men — men capable of providing the leadership, generating the enthusiasm, and organizing a campaign destined to succeed. Finally, a successful activity also requires teamwork — in this case teamwork among individual ASAE members, the ASAE sections, industries interested in agricultural engineering, and college agricultural engineering departments. Following is how the success story unfolded:

The Motion Picture Production Committee, with L. W. Hurlbut, chairman, department of agricultural engineering, University of Nebraska, as chairman, arranged to have a script prepared. During the 1958 ASAE Winter Meeting, the committee reported that a contract had been signed with the Motion Picture Service of the U.S. Department of Agriculture to supervise production of film, supply technical advice for shooting, and exercise full responsibility for making a 14-minute movie in full color. It was evident that ASAE could and would have a movie as soon as it could raise the necessary funds.

J. W. Borden, vice-president of sales, Eversman Mfg. Co., and chairman of the Motion Picture Finance Committee, called a meeting of his committee on the final day of the 1958 ASAE Winter Meeting and announced that the time had come to "get the financing done." Determined to meet the challenge, the committee immediately established a production budget and set as its goal $23,000 to complete the project. In addition to establishing the goal, the committee also came up with a plan whereby funds could be obtained from four major sources, each having a vital stake in agricultural engineering enrollment.

Categories were as follows:

1. Colleges with agricultural engineering departments
2. ASAE sections
3. Industry
4. Special individuals.

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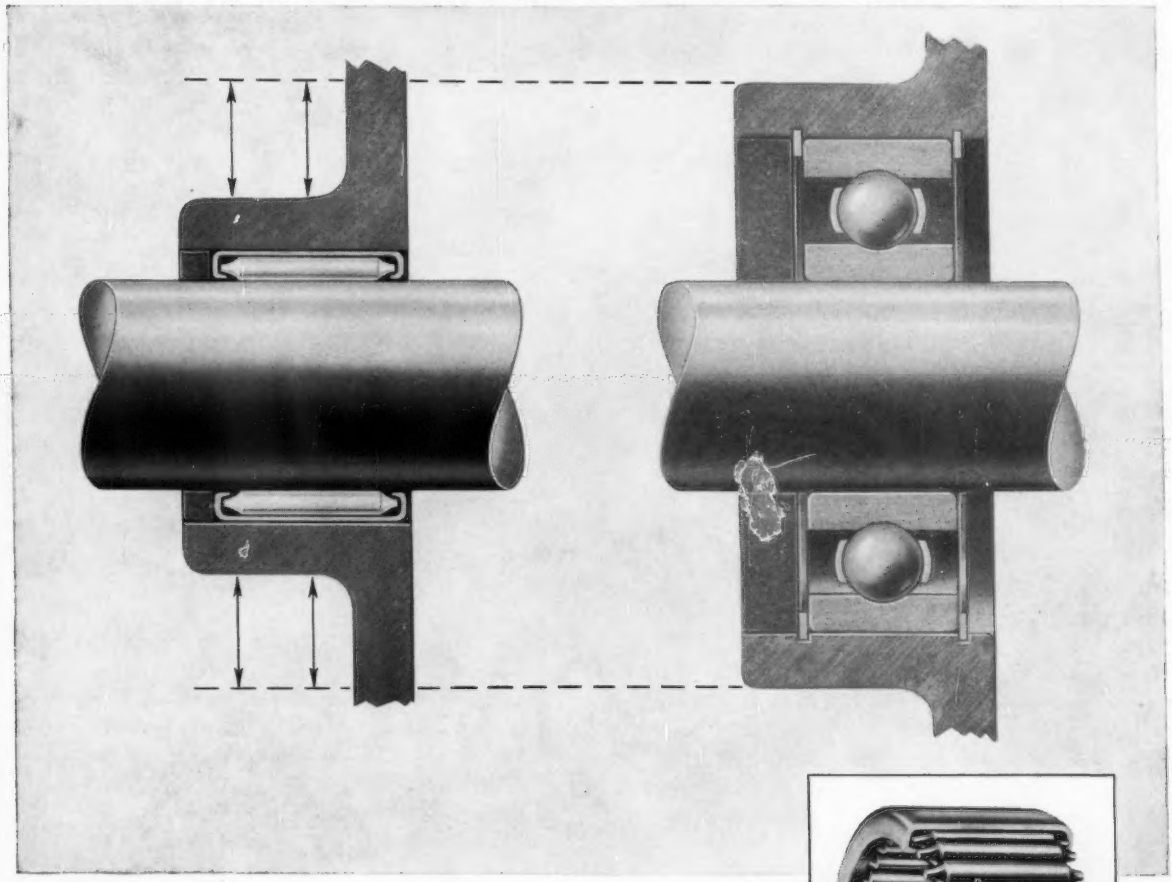

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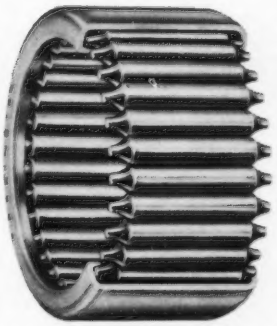
Simpler, more compact design is possible wherever Torrington Needle Bearings are put to work in eliminating friction problems.

These outstanding bearings offer a higher radial load capacity than any other bearing of comparable size. They are more compact, lighter in weight, and are lower in unit cost. The full complement of small-diameter precision rollers insures exceptional antifriction performance and long, maintenance-free service life. The turned-in lips on the outer shell guarantee positive roller retention. Installation and assembly are fast, simple, economical.

The unmatched design and production advantages of Torrington Needle Bearings have been proved in applications ranging from office machines to automobiles, washing machines to earth-moving machinery. Give *your* product the benefit of our antifriction know-how. Write or call Torrington—maker of every basic type of antifriction bearing.



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- Full complement of retained rollers
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- Long service life
- Compactness and light weight
- Run directly on hardened shafts
- Permit use of larger and stiffer shafts

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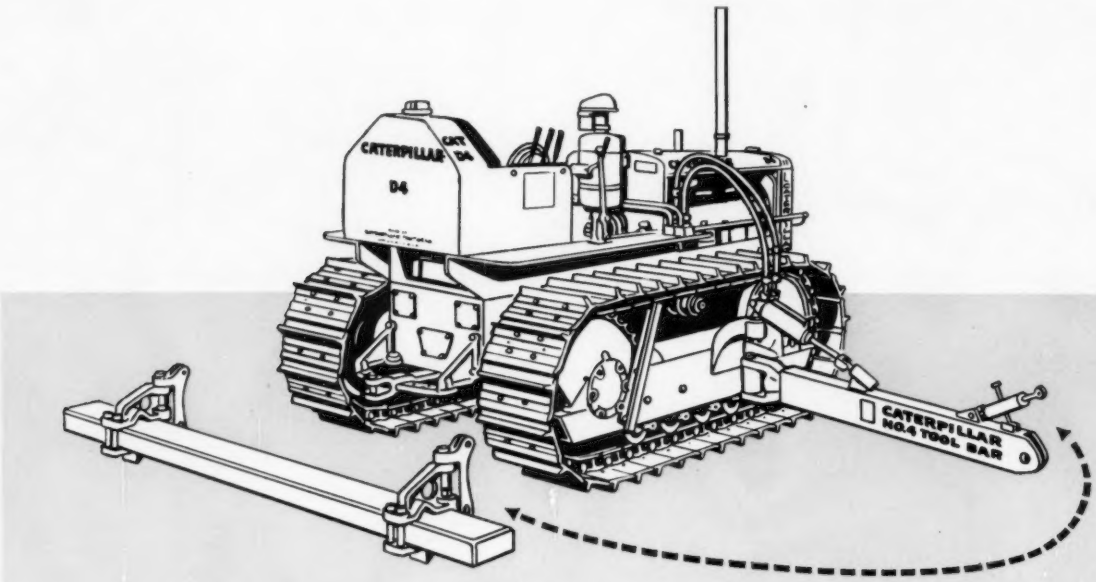

See how easily and economically you can have

Customized Equipment

Now you can easily "customize" equipment to your needs—by using standard attachments and parts you get equipment that performs right and is matched to both the tractor and your farm. You start with a Cat Diesel Farm Tractor equipped with "Swing-Around" Tool Bar. To it you can add or adapt a wide variety of equipment. Illustrated here are just a few:

CULTIVATOR—with Cat Tool Bar you need only basic frame members and ground engaging tools—no extra chassis, controls, etc. Add only the cultivators you need.

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BULLDOZER—swing draft beam forward, and attach dozer blade in just a few minutes. The Cat Diesel Tractor then becomes an efficient tool for land forming, tree and brush removal.

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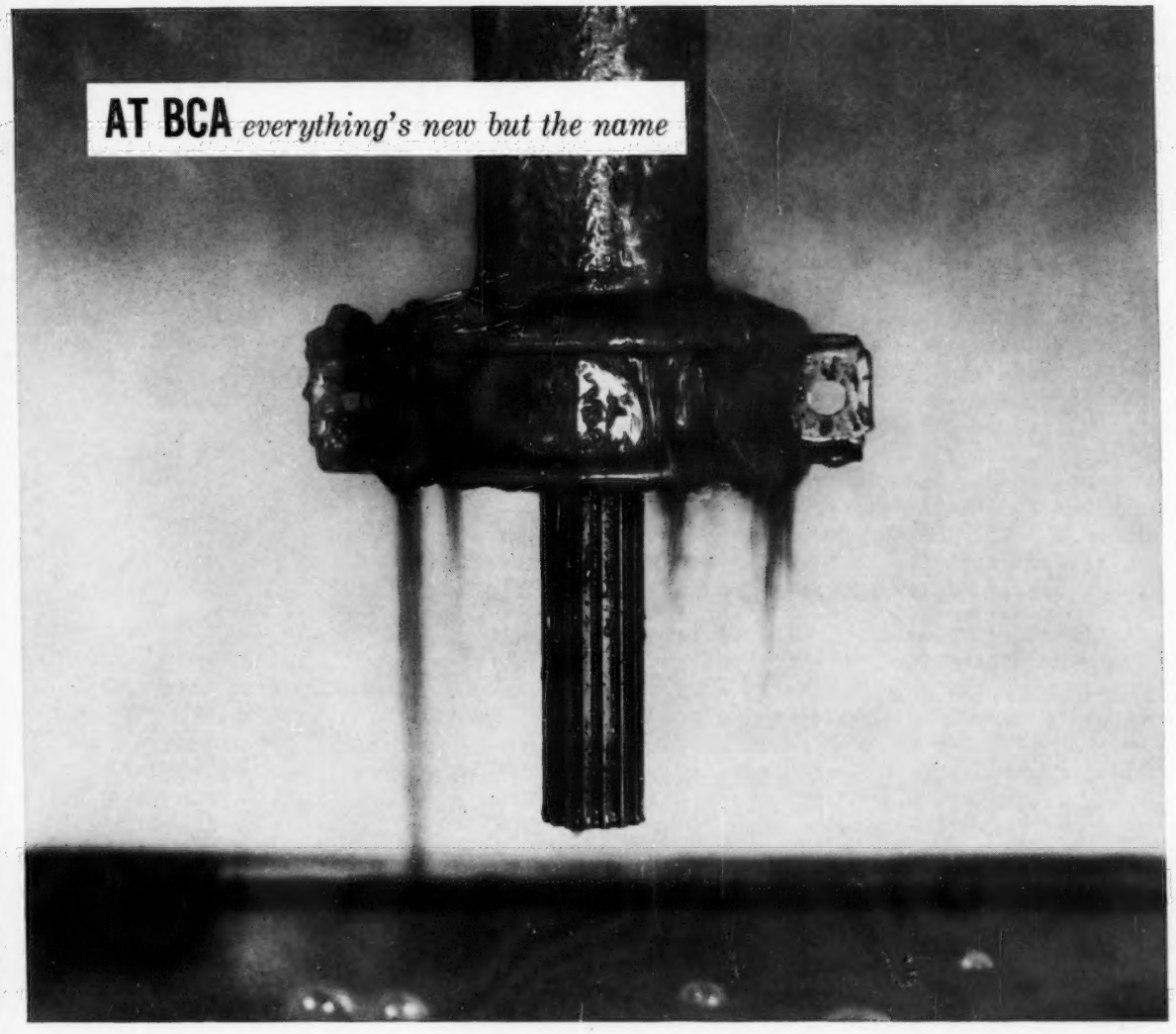

RARE SAND PROVES BEARING DESIGN

in new 100,000-mile test!

The automotive shaft bearing above has just completed the equivalent of 100,000 miles of dusty backroads travel. For hours, it's been alternately spun and stopped in this special mud . . . mud composed principally of a rare type of Arizona sand, *so fine it penetrates almost anywhere water can go.*

The particles of this unique sand are so small that, mixed with water, even filtering won't remove them all. They're highly abrasive, too—so much so that bearing failure quickly occurs whenever particles penetrate into a bearing raceway. Though several score of spin-and-rest cycles in this bath are equal to 100,000 miles of heavy-duty use on the road, the BCA bearings tested on this machine consistently stand up under many more cycles, before failure from sand penetration.

This test is typical of the many being conducted in BCA's new testing laboratories for BCA customers. Here, and in the expanded research laboratories, testing of bearings to exceed customer specifications is a daily occurrence. Often test equipment is specially built to exactly duplicate equipment in the customer's plant.

BCA provides a wide range of ball bearing sizes and types for nearly every kind of industry. This, plus extensive new research, testing, and precision production facilities make BCA a dependable source of long-life bearings. For information, write Bearings Company of America, Division of Federal-Mogul-Bower Bearings, Inc., Lancaster, Pennsylvania.

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Report to Readers . . .

HAMMERMILL PRODUCTION INCREASED WITH THINNER INDIVIDUAL HAMMERS

Tests made at Kansas SU indicate that the production of hammermills can be increased 15 to 25 percent, together with improved granulation of the feed, if operators will use 1/16-inch in place of 1/8-inch hammers. It was found also that it made little difference whether the hammers were grouped or individually spaced. . . . . These tests further showed that additional operating economy is possible by using gravity rather than fan discharge of the ground grain, inasmuch as a fan uses 25 to 30 percent of the total power required. The fan discharge has the advantage, however, in that it helps to increase the production rate an average of 12 percent and also keeps the ground product cooler. If gravity discharge is used, it will still be necessary to pull a small quantity of air through the mill to control the fine dust. . . . . Negative rather than positive pressure is recommended in pneumatic handling of ground feeds. This is based on the fact that the ground product in passing through the fan is ground even finer, which wastes some power and reduces fan life. . . . . The Kansas study further emphasizes that, since hammermill capacity is related directly to how fine the product is ground, it is economically sound to grind feed only as fine as necessary to meet consumer and production demands.

AN AUTOMATIC UNLOADER FOR HORIZONTAL SILOS

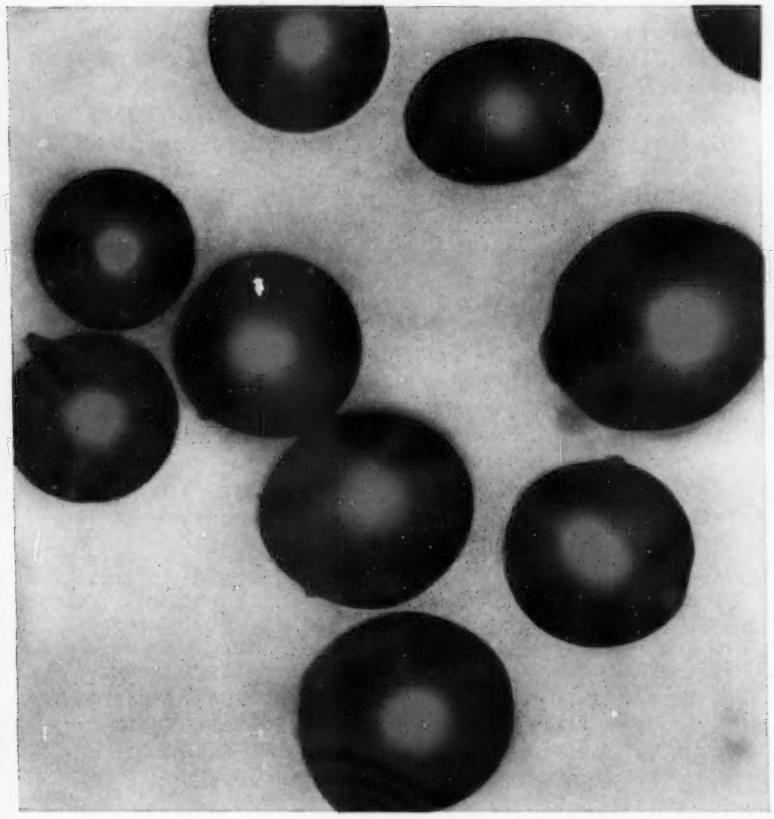
USDA agricultural engineers have developed an unloader for horizontal silos that operates automatically. It is an auger-type device that is expected to have the capacity to unload, convey and distribute practically any type of silage at rates ranging from 175 to 200 pounds per minute. Test results show that the labor and time required were no more than for operating an unloader for a vertical silo. . . . . The device consists essentially of a 12-foot hydraulic lift mounted on an undercarriage adapted from a rubber-tired farm wagon. A frame on the lift mechanization holds a 9-inch auger; the auger motor and speed-reducing unit, together with the conveyor, are also attached to this frame. The conveyor is at right angles to the auger. . . . . The auger, with mower knives attached, removes silage by making a cut 16 inches thick, 10 feet wide, and 12 feet deep from top to bottom of a silo. Such a cut takes about 50 minutes and yields about 6400 pounds of silage. Limit switches at top and bottom reverse the vertical motion automatically. . . . . The auger moves the silage from each side to the conveyor as the mechanism lowers. The silage then enters the conveyor which is free to move up and down as the auger moves. The conveyor will carry silage to a truck or wagon, or supply a second conveying system going directly to feeders for completely automatic operation.

NARROW CORN-ROW SPACING FAVORS LOWER COSTS AND HIGHER YIELDS

While 20-inch corn rows would pose some problems for implement designers, an Ohio AES research team reported to an ASAE meeting that it holds out promise of higher grain and stover yields and fewer nubbins. The result of their tests show that the narrow-row spacing resulted in (1) reducing nubbins from 26 to 15 percent of the crop, (2) increasing the number of ears per 100 plants from 75 to 99, and (3) adding 1/4 ton per acre to the production of stover. Even in a dry year, results from this study indicated still somewhat higher yields from narrow-row corn than from that planted in 40 to 42-inch rows. . . . . While not required for weed control, cultivation of narrow-rowed corn may be essential for high yields on soils that compact or run together as the result of summer rains. The Ohio tests proved, however, that herbicides will eliminate the weed problem in narrow-rowed corn. . . . . The Ohio researchers suggest that a drill-type planter suitable for planting soybeans, sugar beets and corn and a combine harvester equipped with a grain header would reduce over-all equipment cost since all three crops will produce high yields with narrow-row spacing.

(Continued on page 668)

30 MILLION OF THESE JET-FORMED SPHERES IN EVERY INCH OF BEARING SURFACE!



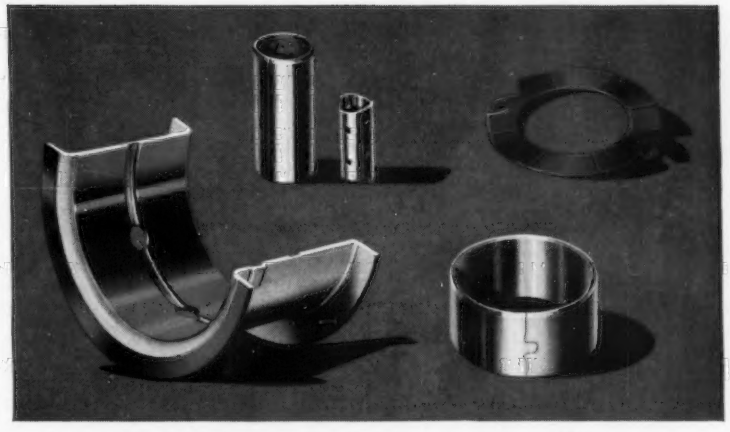
JET PROCESS BLASTS MOLTEN ALLOY INTO UNIFORM PARTICLES . . . so small that thirty million will form a thin layer only one inch square! This sintered layer is the bearing surface of Federal-Mogul sleeve bearings.

Molten copper-lead, alloyed to exact specifications, is poured into a special inert-atmosphere reaction crucible. Here it's blasted by a high-speed fluid jet to form the dense powder shown at left.

Because of the uniform particle size of this powder, the bearing surface of each F-M copper-lead sleeve bearing has precisely the same alloy composition and high adhesion to the steel backing as every other F-M bearing of the same alloy type!

YOU CAN SEE THE CONSISTENT SIZE in the photomicrograph. What you *can't* see is the consistent alloy composition which produces uniform bearing properties and performance in any alloy type.

Federal-Mogul makes engine bearings for every condition of speed and load. You can select from among five different sintered copper-lead alloys, all permanently bonded to precision-formed steel backing. Our Engineering Department is available to you for consultation or recommendations on bearing design and application. For more information, write Federal-Mogul Division, 11081 Shoemaker, Detroit 13, Michigan.



A COMPLETE LINE! Steel backed bearings with a selection of many different alloys for virtually any bearing application—Plain and bimetal bushings in bronze, steel or aluminum. Precision thrust washers in solid bronze, or sintered alloys on steel (one or both faces). Rolled split spacer tubes in steel, aluminum or stainless.

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sleeve bearings
bushings-spacers
thrust washers

DIVISION OF
FEDERAL-MOGUL-BOWER
BEARINGS, INC.

. . . Report to Readers (Continued from page 666)

FIBERGLASS PROVES GOOD SAND FILTER FOR DRAINTILE LINES

A Michigan SU extension drainage engineer says that glass fiber filters are proving to be a good means of keeping sediment out of tile lines laid in sandy soils. Research tests reported show in excess of three times as much sediment in unprotected lines as in lines protected with the glass fiber filters. The same tests indicate nearly twice as much water flowing from the protected as from the unprotected lines. . . . . The test results reported further show that each cubic foot of water that entered the unprotected tile lines contained about seven times as much sediment as water entering the protected lines. According to this Michigan engineer, the use of glass filter materials as a means of protecting draintile lines in sandy soils looks very promising. Also, as a practical hint, he recommends that, before backfilling, two to four inches of topsoil be placed by hand over the glass fibers, after they are laid on the tile, to prevent tearing and breaking.

X-RAY ANALYSIS OF GRASS SEED CLOSE TO 95 PERCENT ACCURATE

A USDA agricultural engineer told an ASAE meeting that the more than 6 hours required by a trained seed analyst to determine the purity of a sample of grass seed (3,000 seeds) can be reduced to 30 minutes by exposing the seed to X rays. . . . . The mechanical seed-handling device developed for the purpose permits continuous X-ray inspection of individual seeds. Seeds of various grasses absorb the X rays in varying degrees and permit calculating purity in a sample as the individual seeds are scanned by a cadmium sulfide crystal photocell at the rate of 100 seeds per minute. . . . . The X-ray method of analysis is about 95 percent accurate, and it has the added advantage of reducing human errors and does not require a highly trained technician.

DISCOMFORT INDEX USEFUL IN DESIGN OF SUMMER SHELTERS FOR DAIRY COWS

A Michigan SU agricultural engineer recommends that summer shelters for dairy herds be designed to keep the discomfort index, a measure of combined heat and humidity, at 75 or less. This recommendation is based on a three-year study of the effects of temperature and humidity on Holstein cows which this engineer recently completed at the climatic laboratories of the University of Missouri and the U. S. Department of Agriculture. Such a discomfort index will provide a maximum range of temperature of 77 degrees with 80 percent relative humidity to 90 degrees with 15 percent relative humidity. Results of the study show that, when temperature and humidity are too high, feed consumption and milk production will drop. An important result of this study is that it determines values that can be used in designing air-conditioning equipment for a shelter. . . . . Another part of this study indicates the minimum shelter requirements needed to maintain milk production during a hot summer.

MINIMUM TILLAGE OFFERS THREE-FOLD ADVANTAGES

Referring to "minimum tillage" as actually a principle rather than a definite farm practice, a Michigan SU extension soil and water conservationist says that, in addition to boosting yields, it also saves valuable soil and water. Comparing research results in another state of wheel-track and conventional corn planting on a 5 percent slope, this scientist reports yields of 69 bushels per acre for conventional-planted plots and 76 bushels per acre for wheel-track planting. . . . . These same tests showed even greater differences in loss of soil and water. On conventional-planted plots, erosion was at the rate of 14 pounds of soil for every bushel of corn produced, while in the case of wheel-track planting the erosion loss was only one pound per bushel. . . . . Another significant result brought out in these research data was that about 15 percent of the summer rainfall was lost by runoff on conventional plots, while in the case of wheel-track planting it was reduced to 3 percent.

TEAR OUT AND PUNCH AS INDICATED FOR YOUR FILE

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One in a series of technical reports by Bower

BEARING BRIEFINGS

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To develop high capacity and optimum performance in a tapered roller bearing, it is essential that roller alignment be accurate. Correct roller alignment, in turn, depends on a critical geometric relationship between the cone back-face rib, and the cone raceway.

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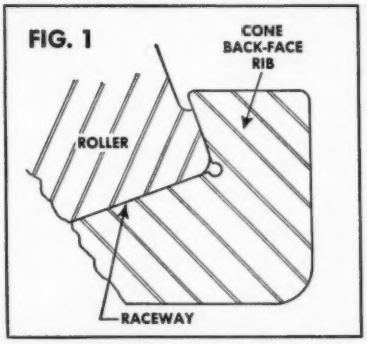
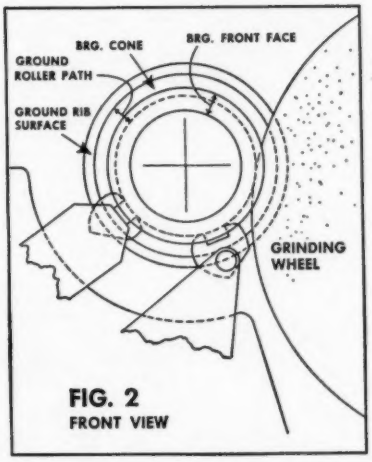


load. As engineers know, poor performance and premature bearing failure are inevitable under these conditions.

In the design and manufacture of Bower tapered roller bearings, Bower engineers take great care to generate and hold an exact face angle on the cone back-face rib. In practice, this means that Bower



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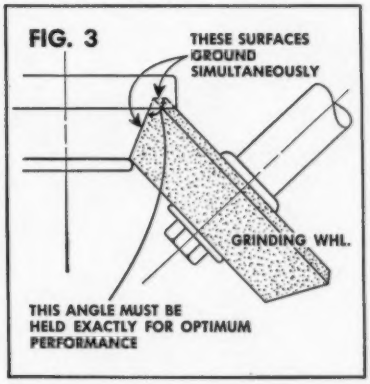
Figures 2 and 3 are front and top views which illustrate Bower's technique of centerless grinding rib-faces and cone raceways together. As a result, every component in a Bower bearing is perfectly concentric about its rolling axis.



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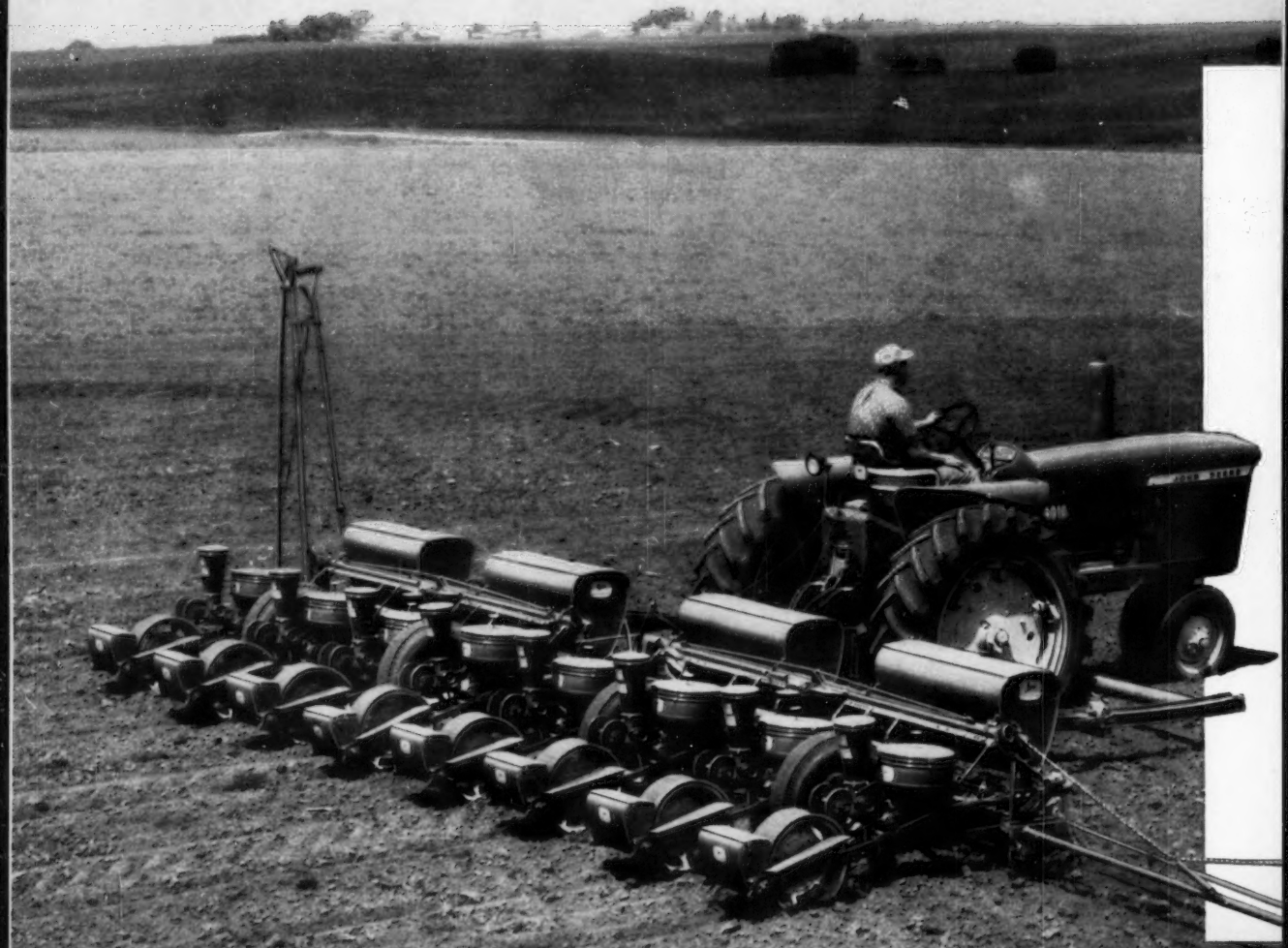

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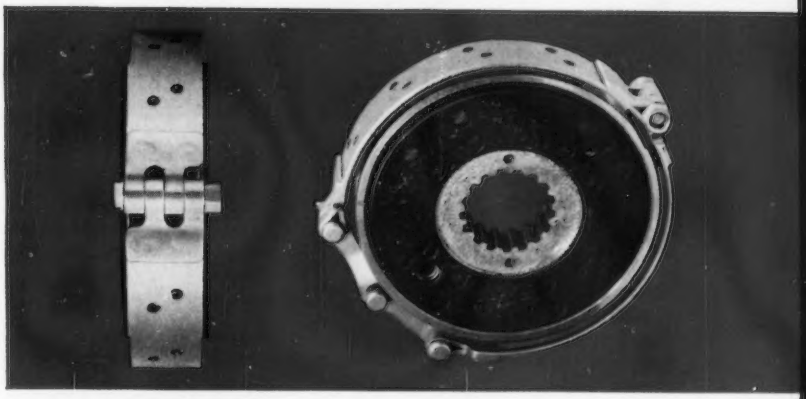

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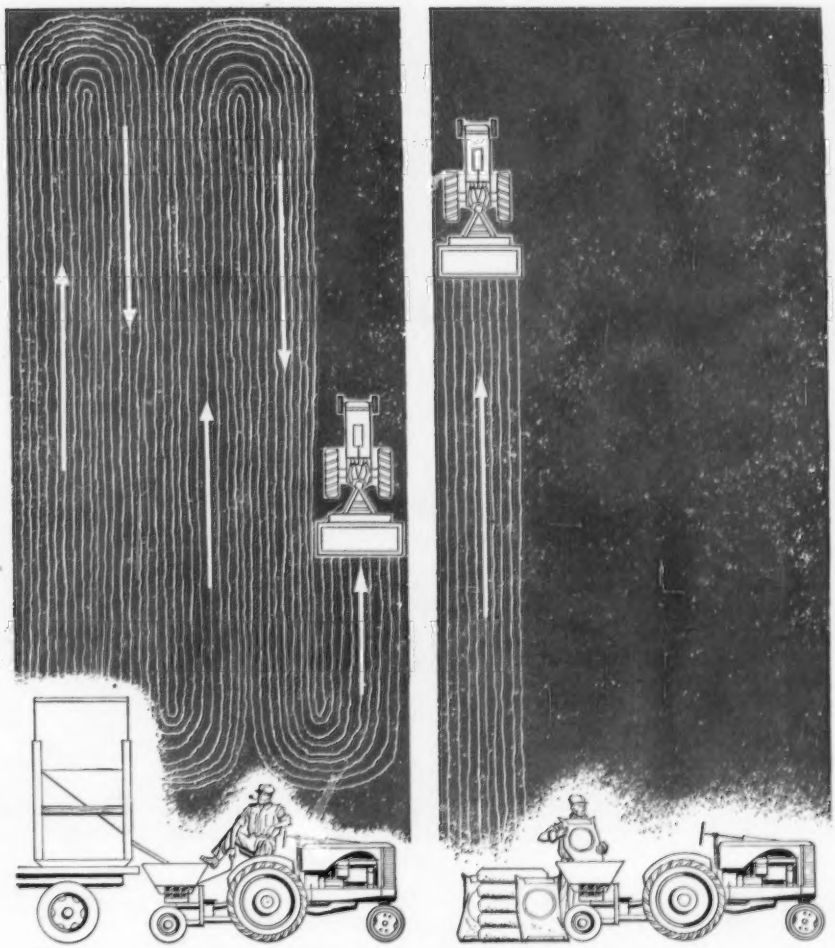

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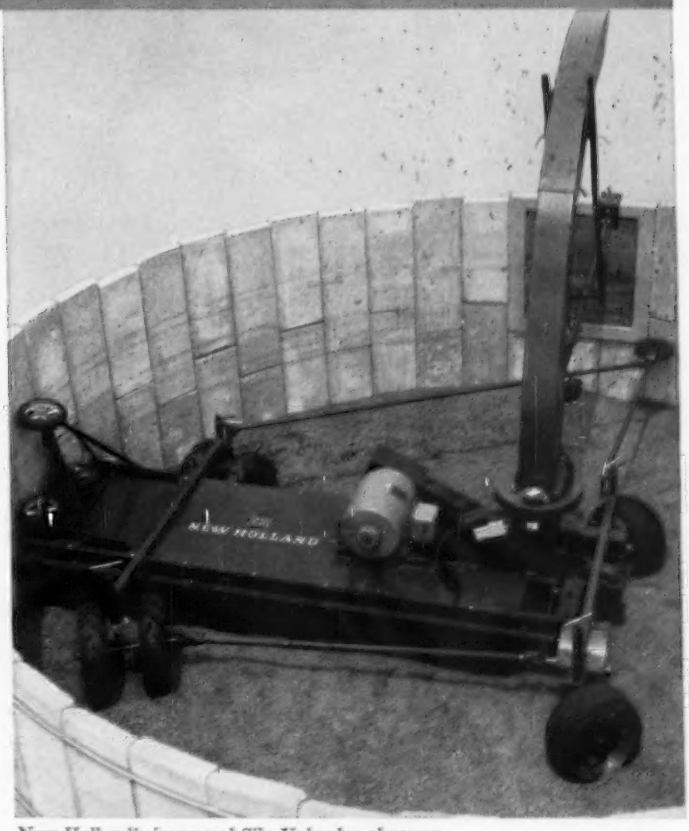

New Holland's improved Silo Unloader plays an important role in a modern silage-handling system.

New Holland's Silo Unloader-Bunk Feeder team is an important part of a silage mechanization program

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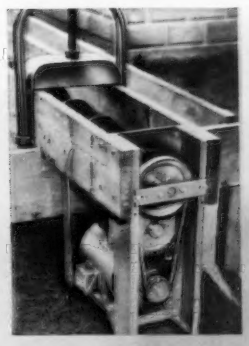

2. The fine-chopped silage is blown into a side- or rear-unloading wagon—the Model 3 Crop-Carrier is a good example. A wagon like this makes short work of unloading into a New Holland blower, which whisks forage into the silo for storage.

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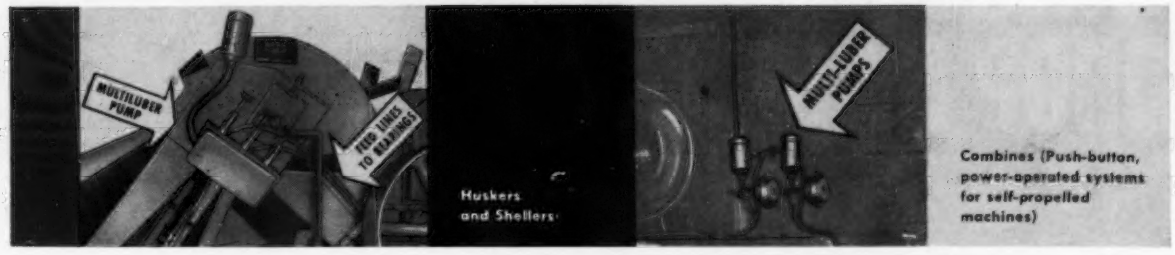

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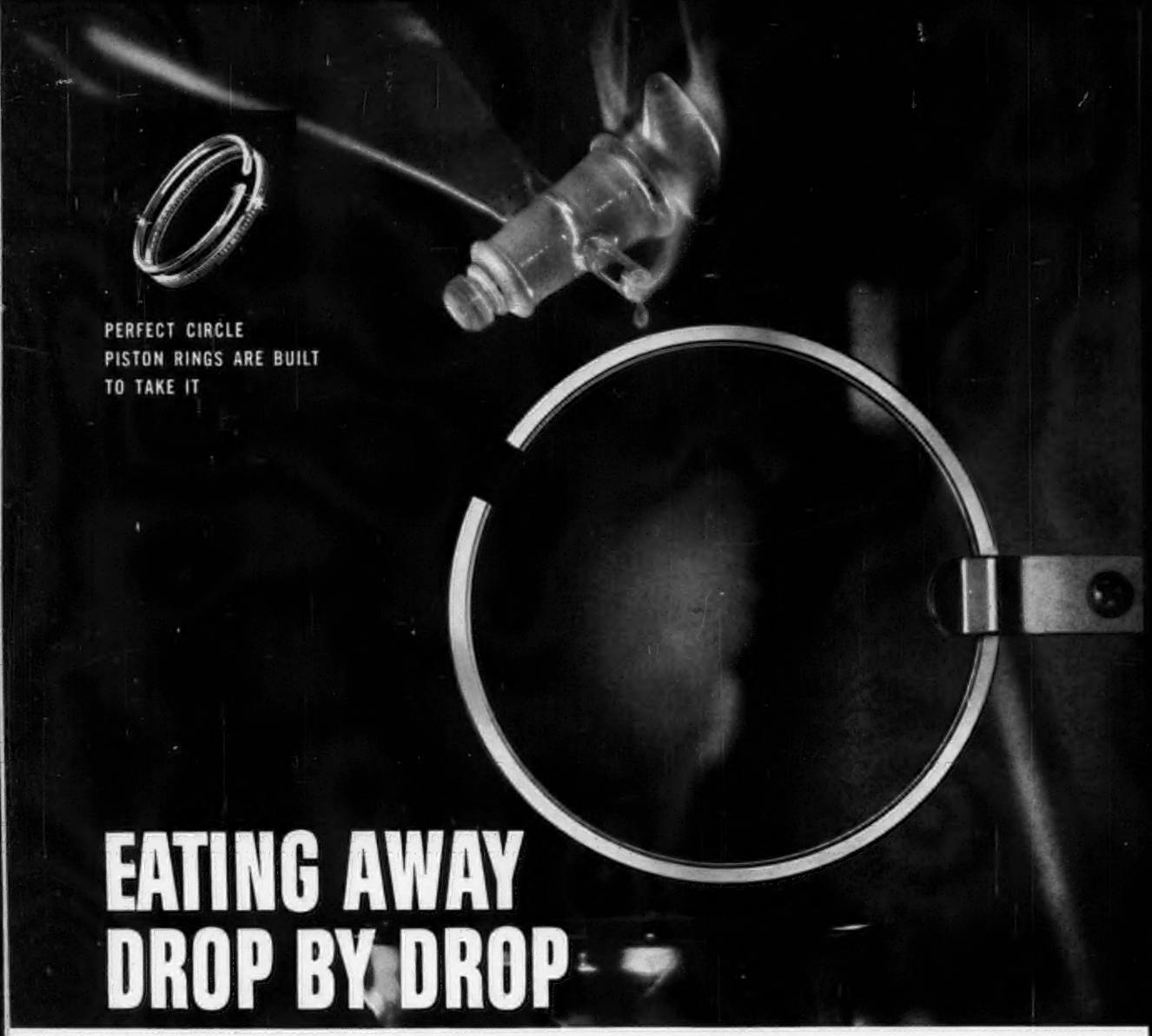

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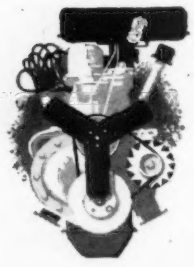

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Agricultural Engineering

October 1960
Number 10
Volume 41

James Basselman, *Editor*

POWER TO PRODUCE

The 1960 Yearbook of Agriculture Devoted Primarily to Engineering in Agriculture

NEW recognition and testimony to the great contribution engineering has made to America's agriculture is offered in the 1960 Yearbook of Agriculture entitled "Power to Produce." The 1960 Yearbook, written in layman's language primarily for nontechnical people, traces engineering contributions to farm technology through such broad headings as "Power in the Past," "Power in the Present," "Power on the Land," "Power in the Harvest," "Power and Livestock," "Power in the Market," "Power and Efficiency," "Power and Its Effects," and "Power in the Future."

Power to Produce is the latest in a series of comprehensive Yearbooks published by the U.S. Department of Agriculture since 1936 — and the first one devoted primarily to the *engineering* contributions to agriculture. Every agricultural engineer should obtain a personal copy and should see that copies are available in school libraries and other places where the contribution of agricultural engineering to agricultural progress should be made available for reference, for study, and for inspiration. *Citizens of the United States may obtain copies by directing a request to the Congressman or Senator serving their respective districts. Copies can be bought at $2.25 each from the Superintendent of Documents, Washington 25, D. C.*

Power to Produce was written by 90 engineers and technicians in the USDA and industry and was edited by Alfred Stefferud, who has been editor of the Yearbook since 1945. It contains 60 chapters and 480 pages, including 96 pages of photographs.

Secretary of Agriculture Ezra Taft Benson points up the future significance and challenge of engineering in agriculture in his foreword in which he says:

"The value of this book is that it pictures on a wide screen and in sharp focus the technological revolution that now is changing not only agriculture but our way of living. . . . .

"The revolution gives us new benefits every month, even every day — better food and more of it, improved industrial products, less work, more leisure . . .

". . . (but) the mere possession of tools, gadgets, machines, packages, things is not enough. Wisdom requires an understanding of what the march of technology can do to people and for people.

"We must make the most of the extra food technological advances provide.

"It must be made available for sale in all markets, at home and abroad. It should be shared with the needy wherever possible. It should be, as President Eisenhower has said, 'Food for Peace.' "

ASAE expresses its congratulations and gratitude to Secretary Benson, to Editor Stefferud, to the Committee Members for the 1960 Yearbook of Agriculture, and to all the authors (mostly ASAE members) for this splendid documentation of the contribution of power and engineering to American agriculture. Simultaneously, as the profession largely responsible for the application of power for agricultural uses, let us rededicate ourselves to the task of continuing progress in this work for the benefit of mankind.

President Eisenhower and Secretary Benson are Honorary Members of ASAE.

Attention Movie Committees

ATTENTION Section Career Guidance Committees and Agricultural Engineering Departments—Late word indicates that several magazines will carry announcements concerning the availability of the ASAE career motion picture. This should result in a number of requests — so be prepared to follow up on them as described in the Five-Step Plan.

A list of the magazines which will carry a notice about the picture (and which notify us) will be carried in a subsequent issue of AGRICULTURAL ENGINEERING.

ASAE Winter Meeting • Peabody Hotel, Memphis, Tennessee • December 5-7, 1960

Development of a Mechanical Tomato Harvester

Machine based on the once-over harvesting principle

B. A. Stout and S. K. Ries
Member ASAE

THE farm value of tomatoes grown for processing purposes in 1958 exceeded 100 million dollars in the United States. The harvesting costs were over 30 million dollars. Labor for harvesting tomatoes and other vegetable crops is becoming more difficult to procure and more expensive.

The need for a mechanical tomato harvester is apparent to everyone associated with the tomato-processing industry. For many years, mechanical harvesting of tomatoes was considered impossible because of the wide variation in the date of maturity of fruit on the plant and the random location of ripe fruit. The fact that ripe tomatoes are soft and easily broken makes the problem more complex. Recently, however, Fairbanks (1)* reported on the work of Lorenzen and Hanna in California, who proposed the "once-over" harvesting idea for tomatoes. This idea of course requires a variety that ripens most of its fruit at one time. Hanna has worked for many years to develop a tomato plant with characteristics suitable for mechanical harvesting. Lorenzen outlined the following operations which a tomato harvester must perform: *(a)* cut the plant root system, *(b)* lift the vine, *(c)* remove the fruit, and *(d)* transport the fruit to some type of receptacle. Stevenson and Tomes (2) reported dwarf varieties which appeared promising for once-over mechanical harvesting. They reported yields of 12 tons or more per acre in a single picking. Thus it appears practical to design a tomato harvester based on the once-over principle.

Paper presented at the Winter Meeting of the American Society of Agricultural Engineers at Chicago, Ill., December 1959, on a program arranged by the Power and Machinery Division. Revised for publication June 1960. Authorized for publication as Journal Article No. 2649 of the Michigan Agricultural Experiment Station.

The authors — B. A. STOUT and S. K. RIES — are, respectively, assistant professor of agricultural engineering and associate professor of horticulture, Michigan State University, East Lansing.

Acknowledgment: The authors express appreciation to the Chisholm-Ryder Co., Niagara Falls, N. Y., and to many tomato-processing companies for their cooperation in connection with the research study reported in this paper.

*Numbers in parentheses refer to the appended references.

1960 model mechanical tomato harvestor undergoing field tests in Florida

The Tomato Plant

Hundreds of tomato varieties are grown in various areas throughout the world. Relatively few varieties, however, have the necessary yield, quality and disease resistance demanded by the food processor. Few, if any of the commercially acceptable varieties now grown possess the qualities required for efficient mechanical harvesting.

A typical commercial variety, Campbell 146, when planted in rows five feet apart, normally covers the entire ground area at harvest time. A harvester designed for Campbell 146 and other varieties producing large plants would require a pickup bed at least five feet wide. Smaller plants of determinant or dwarf varieties are being developed by plant breeders. Several varieties have been developed which produce mature plants as small as 18 to 30 in. in diameter. It does not appear that plant size will present any great problem to the harvester designer since many new determinant varieties are becoming available.

If once-over harvest is to be practical, concentrated fruit set and uniformity of ripening are prerequisites. Most of the present-day fresh market and processing varieties do not possess this quality. Fig. 1 shows the fruit from a single

PLANT BREEDING KEY TO MECHANICAL HARVESTING

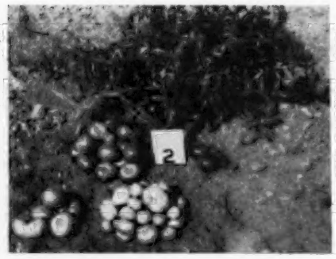
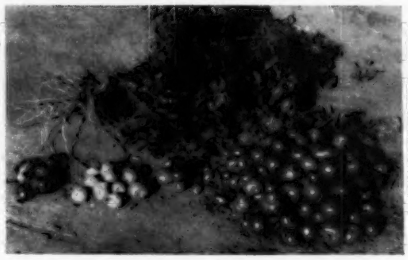


Fig. 1 *(Left)* Fruit from a single tomato plant of variety Campbell 146: *(Upper left)* ripe, grade 1; *(Upper right)* ripe, broken; *(Lower left)* turning; and *(Lower right)* green

Fig. 2 *(Right)* Fruit from a single tomato plant of variety Libby C-52. *(Left to right)* Ripe broken, green, turning, ripe grade 1



plant of the Campbell 146 variety selected at random. The ratio of ripe to green fruit is unacceptably low from this variety which is typical of those being grown for processing in the eastern part of the United States. Some of the new determinant varieties, fortunately, have a much higher ratio of ripe to green fruit at harvest time. A variety exhibiting an unusually high ratio of ripe to green fruit is shown in Fig. 2. This is C-52, an experimental variety developed by Libby, McNeill and Libby.

It is commonly known that tomatoes are soft and easily bruised. When used for processing purposes, however, some internal bruising during harvesting can be tolerated if the fruit is handled promptly. Minor surface cracks may also be permissible.

The 1958 Model Tomato Harvester

Tests in 1958 using an experimental cucumber-harvester shaker bed (3) indicated that tomatoes could be shaken off the plant effectively at 215 cycles per minute with a 4-in. stroke. This observation led to the construction of the crude tomato harvester shown in Fig. 3 in 1958. This machine was designed to cut the plant below the soil surface using a standard potato digger blade, elevate the entire plant to a shaker bed, remove the fruit and catch it on a wire screen. These basic principles were used in developing the 1959 and 1960 models. It is considered necessary to have the pickup below the soil surface, since in the case of many varieties large percentages of ripe fruit fall from the plant due to vibration during the initial contact of the machine with the plant. Under certain soil conditions this type of pickup might be impractical and have to be replaced by an above-the-surface pickup. The rods in the shaker bed were spaced on five-inch centers. The bed was shaken in a four-inch stroke at approximately 200 cycles per minute. The shaker bed sloped to the rear so the plants would slide off the bed onto the ground.

Many shortcomings were apparent as soon as the machine was field tested. The elevator chain was only 22 in. wide and many varieties of tomatoes produce plants which, when mature, spread to 4 or 5 ft. Therefore, the plants did not flow into the harvester properly. The sloping shaker bed was inadequate for discharging the plants. A positive plant removal mechanism was obviously needed. The fruit-catching device was inadequate also. The soil which was elevated along with the plant was stored with the harvested fruit and would have to be removed.

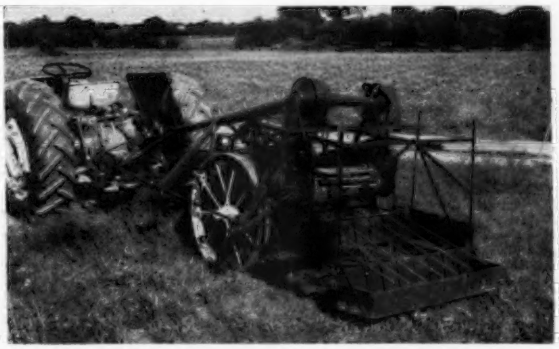


Fig. 3 1958 model tomato harvester consisting of a potato digger with shaker bed and catching frame attached to the rear

Since the principle of elevating the entire plant and then shaking the fruit off appeared sound, another model was built in 1959.

The 1959 Model Tomato Harvester

The 1959 model mechanical tomato harvester was constructed using a potato digger with an elevating chain 30 in. wide as a basic frame.

Pickup Mechanism. Considerable difficulty was experienced in developing a good plant pickup mechanism. Figs. 4 and 5 show two types of cutters which proved satisfactory. The open-center blades (Fig. 4) are standard for potato diggers in some areas. The sweeps (Fig. 5) run shallower and therefore are more desirable. With both types of cutters there was a tendency for plants and soil to accumulate near the leading edge as the machine moved forward. Therefore, the overhead gathering chain with extended metal fingers, shown in Fig. 6, was added to hold the plants while the elevator chain moved under them. There was

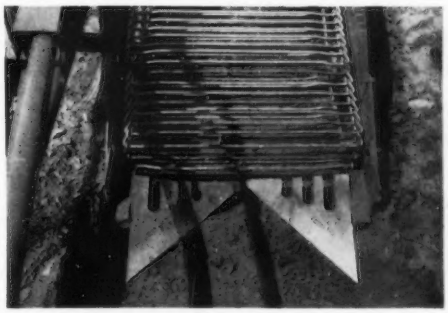


Fig. 4 Open-center blades for lifting tomato plants onto the elevator chain

Fig. 5 Sweeps for cutting tomato plants just below the soil surface

Fig. 6 Complete vine pickup mechanism used in 1959

. . . Tomato Harvester

about three inches clearance between the ends of the metal fingers and the elevator chain to minimize fruit breakage. A set of four 5/16-in. diameter parallel rods was attached to the frame to act as a stripper to prevent plants from lodging in the overhead chain.

The 30-in. width proved inadequate for some of the larger varieties. The pickup nose and rolling coulter shown in Fig. 6 were added to enhance the flow of plants into the machine. Neither of these devices are permanent solutions to the pickup problem, but enabled performance tests to be completed.

Elevator. The standard potato chain served as an elevator. It carried the plants and fruit up a 22-deg incline to the shaker bed.

Shaker Bed. Two shaker beds were used. One was constructed of 5/16-in. rods on 4½-in. centers (Fig. 7); the other of ½-in. electrical conduit on 5½-in. centers. The larger diameter conduit exerted lower pressures on the fruit and therefore caused slightly less breakage. Furthermore, the conduit was more resistant to corrosion by the acids in the tomatoes than the cold-rolled steel rods.

A Massey-Ferguson "dynabalance" mower drive was used to drive the shaker bed. This unit had a 2½-in. stroke. A lever mechanism (Fig. 7) was designed to provide shaker bed strokes ranging from approximately 3 to 5 in.

Figure 7 also shows the overhead chain with extended metal fingers which carried the plants to the rear of the shaker bed where they dropped onto the ground. Stripper rods were added later to prevent the plants from catching on the fingers and passing over the top of the overhead chain (Fig. 8).

Cleaning Belt. A rough-surfaced belt 30 in. wide was mounted at a 17-deg angle to the horizontal beneath the shaker bed to receive the fruit. The belt moved up the slope carrying dirt and foreign material out at the top. The tomatoes, being nearly round, rolled down into a suitable container. Under certain conditions the 17-deg incline was insufficient which resulted in some fruit being discharged from the top of the belt.

Conveyor. Field tests indicated the small container was inadequate, so a conveyor (Fig. 8) was added to carry the fruit to a trailer towed behind the harvester. The conveyor chain traveled at 60 fpm up a 30-deg slope.

Complete Machine. The complete machine as it appeared at the end of the 1959 season is shown in Fig. 9. Since this is a towed machine, any two or three-plow tractor having a standard power take-off would provide a suitable power unit. The power requirements were low (maximum drawbar pull being 600 lb) in the soils tested because the cutting knives operated just below the soil surface. The total weight of the complete machine (excluding tractor and trailer) was 2300 lb.

1959 Mechanical Harvester Tests

Ten tomato varieties were grown on the Michigan State University horticultural farm for evaluating the mechanical harvester. These varieties were: Fireball, Purdue 58-4-96 (Epoch), Redtop Y-9 (University of California), 11-1-12-13-1 from Vineland, Ontario, Oregon State College dwarf, Harris No. 1, Harris No. 2, Maryland 314, Campbell 146, and Urbana.

The results of tests involving three varieties which appeared promising for mechanical harvest are given in Table 1.

TABLE 1. RESULTS OF 1959 MECHANICAL TOMATO HARVESTER TESTS

Variety	Plot No.	Yield, ripe grade No. 1 fruit, tons per acre	Total yield, tons per acre	Percent of ripe fruit broken
Fireball	1	3.0	15.4	25.7
	2	5.0	16.6	18.6
	3	6.4	28.9	9.5
Purdue 58-4-96 (Epoch)	1	2.0	27.3	27.7
	2	3.8	25.8	18.7
	3	9.9	31.4	12.3
	4	6.7	21.4	18.1
Maryland 314	1	3.7	32.3	23.7
	2	6.5	36.1	10.1
	3	9.0	23.8	7.8

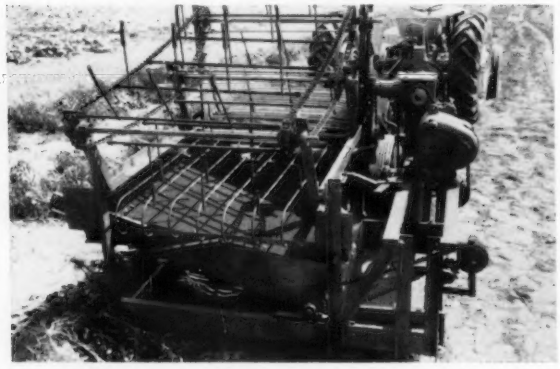


Fig. 7 Rear view of 1959 model tomato harvester showing the shaker bed, lever mechanism and overhead chain

Fig. 8 Side view of 1959 model tomato harvester showing stripper rods and conveyor for carrying fruit to trailer towed behind

Fig. 9 Over-all view of mechanical tomato harvester at the end of the 1959 season

The best results of the season were obtained in a field of tomatoes (Variety C-52) provided by Libby, McNeill and Libby, Ltd., of Chatham, Ontario. Eighteen tons per acre of ripe, No. 1 grade fruit were harvested mechanically in a field yielding 25 tons per acre in a single hand harvest.

Discussion

The average yield of tomatoes in 1958 was 12.7 tons per acre in Michigan and 12.6 tons per acre in the United States (4). The data in Table 1 show that "once-over" mechanical harvesting did not result in yields as high as present-day averages. With an improved machine and better varieties, higher yields can be expected.

A number of problems were encountered during the 1959 tests. The main elevator was not wide enough to handle some of the larger varieties that were harvested. The pickup device was not rugged enough. The shaker bed was too short. The lever mechanism used to lengthen the shaker stroke was awkward. The slope of the trash-removal belt was not great enough. No provisions were made for a sorting table where green fruit, rocks and other foreign material could be removed. These and other mechanical deficiencies will be eliminated in the next model. Perhaps the greatest problems to be solved before mechanical tomato harvesting can be used commercially are scheduling of harvest and fruit-handling systems. Proper scheduling may require several tomato varieties which ripen at different times plus staggered planting, and generally improved cultural practices. Efficient operation of the processing plant and the harvester demands that the harvest season be extended over a period of four to six weeks.

The proper materials handling system for moving tomatoes from the field harvester to the processing plant is unknown. Palletized bulk boxes and handling in water are commonly discussed, but further research will be necessary to provide a practical answer.

The 1960 Model Tomato Harvester

The 1960 model mechanical tomato harvester was designed to overcome the deficiencies apparent in the 1959 model. The main elevator which carries the plants from the pickup device to the shaker bed was 48 in. wide. The shaker bed was 48 in. wide and 48 in. long. A sorting platform was provided above the main elevator with space for six workers to remove foreign material and green or damaged fruit.

The 1960 model harvester was tested in Florida in a field of tomatoes provided by the Campbell Soup Company. Observations were made which will lead to further modifications before the 1960 harvest season in Michigan.

Summary

A mechanical tomato harvester was developed based on the "once-over" harvesting principle. The plants are cut off just below the soil surface and elevated to a shaker bed which reciprocates with a 4-in. stroke at 175 to 200 cycles per minute. All the fruit is shaken from the plant onto an inclined rubber belt. The tomatoes roll down the slope into a conveyor while the dirt and foreign material is carried up the slope and discarded. The fruit is stored in any suitable container.

This principle of harvesting requires a variety which has concentrated fruit set (i.e., a high ratio of ripe to green fruit at harvest time) in addition to the usual requirements of processing tomato varieties. Several promising varieties are being developed by the plant breeders.

Mechanical harvester tests were conducted on ten varieties at the Michigan State University horticultural farm and two varieties in commercial fields. Mechanically harvested yields from the more promising varieties in the Michigan State University plots ranged from 2.0 to 9.9 tons of ripe fruit per acre. Eighteen tons per acre were obtained in one mechanically harvested commercial field.

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2 Stevenson, E. C. and Tomes, M. L. The commercial potential of the dwarf tomato, Proc. Amer. Soc. Hort. Sci., 72:385-389, 1958.

3 Stout, B. A. and Ries, S. K. A progress report on the development of a mechanical cucumber harvester, Michigan Agr. Expt. Sta. Quart. Bul. 41(3):699-718, 1959.

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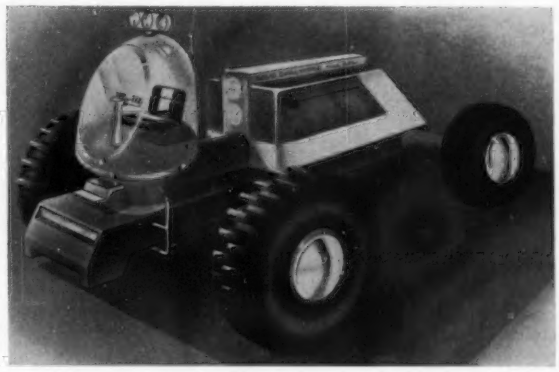
Futuristic Fuel Cell Tractor

THE aspects of an experimental tractor powered by electric current generated in fuel cells were presented in a paper given at the 1959 ASAE Winter Meeting, by Harry K. Ihrig, Allis-Chalmers Mfg. Co. This was also reported



in the April, 1960, issue of AGRICULTURAL ENGINEERING (Page 232). The report gives a resume of the fuel cell principle, and the complete construction details of an electric-powered tractor. The new development has caused concern as to its most useful applications. A-C Research Laboratories' engineering scientists are now actively considering the form that a fuel cell tractor of the not-too-distant future may take. Shown is a concept that presents a fuel cell tractor whose operator would sit in a high-visibility, air-conditioned "pod." Drive would probably be through individual pancake motors in each wheel. Ideal weight distribution would be accomplished by location of fuel cells.

Stressed-Skin Panel Design

Its use in erecting roofs for farm shelters

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THIS paper describes three years of experiments and their results at the Oklahoma Agricultural Experiment Station on the performance and use of selected stressed-skin panel designs for erection of roofs for farm shelters. The objective was to obtain information on structural capabilities and erection requirements of stressed-skin panels of designs which were thought to be desirable because of structural efficiency and convenience in erection.

The research included:

Experiments on structural stiffness of stressed-skin panels fabricated from plywood and cement asbestos, respectively, for the skin with undressed 1 x 6-in. and dressed 2 x 4-in. longitudinals

Erection trials in which stressed-skin panels were used on an umbrella-type hay storage, a small livestock shade, and a one-hinged arch hay storage and livestock shelter.

Data and results were obtained on stiffness factors for selected designs of flat and curved panels. Observations were made on the effectiveness of selected erection methods.

Background

A stressed-skin panel is a structural component that consists of longitudinal members to which is bonded a cover or skin on one or both faces of the panel. A stressed-skin panel with a single cover is illustrated in Fig. 1. The skin, if adequately bonded to the longitudinals, will in combination with them comprise a T-beam section with a considerably greater moment of inertia and section modulus than possessed by the longitudinals alone. Additional elements that may be included in the panel are end headers and transverse stiffeners. The latter help to stiffen the skin under transverse bending and to resist transverse buckling when the skin is in longitudinal compression due to longitudinal bending loads.

Stressed-skin panel construction appeared to meet certain requirements for efficient, rapid construction of roofs for farm shelter buildings. Some possible advantages that became apparent from a rational analysis including the following:

Structural Efficiency. The skin functions both as the roof deck and part of the basic framing system. Compared to a conventional rafter and purlin or deck plus covering system, a saving of material without reduction in structural strength or stiffness is achieved. Also, if the skin is weather-resistant, the panel is the only component needed to complete the roof.

Preassembly. Stressed-skin panels assembled in a shop or at the building site eliminate some of the hazard and difficulty of construction work in place on the roof frame. Panels can be preassembled and stockpiled either on the farm or in the shop during slack time in other activities.

Rapid Erection. After the main structural frames (trusses or arches) have been erected, the stressed-skin panels can be rapidly installed compared to in-place construction with conventional roof systems.

Increased Usable Space. Stressed-skin panels for spans of as much as 12 to 16 ft can be fabricated and handled with reasonable facility. The space under the roof is unobstructed in the wide interval between trusses or arches. This would permit greater freedom in the installation of overhead bins or conveying equipment, compared with roof framing with trusses or trussed rafters at spacings of 4 to 6 ft or less.

Increased Lateral Stiffness of Roof. Diaphragm action of stressed-skin panels conceivably could increase stiffness of the roof under horizontal loads such as horizontal components of wind loads. More of the horizontal load would be transferred to the stiffer end walls and less would be transferred to intermediate structural bents, which could therefore be lighter.

Self-Alignment of the Structural Frame. Stressed-skin panels can be assembled in a jig to close size and shape tolerances. If the panels are designed to nest between the main framing members, the main frames are automatically aligned and squared up as the panels are placed.

Basic Mechanics

The flexural properties of a stressed-skin panel are computed on the basis of the panel cross-section considered as a T beam. If the elastic moduli of the skin and longitudinal materials, respectively, are different, a transformed section analysis can be applied. The skin must be adequately bonded to the longitudinals so that horizontal shear at the juncture of the skin and longitudinal can be resisted with-

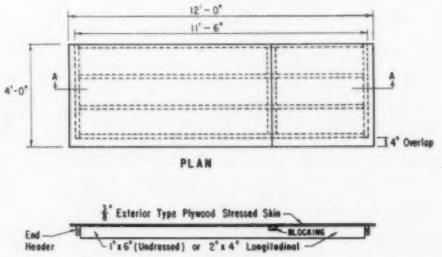


Fig. 1 Stressed-skin panel for application to farm-building roof construction

Paper presented at the Winter Meeting of the American Society of Agricultural Engineers at Chicago, Ill., December 1959, on a program arranged by the Farm Structures Division.

The authors — G. L. NELSON, G. W. A. MAHONEY, J. I. FRYREAR, and D. MARTINSON—are, respectively, professor, assistant professor, and chief draftsman, agricultural engineering department, Oklahoma State University, and mathematics instructor, Wichita (Kans.) North High School.

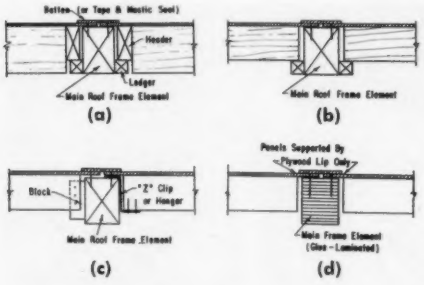


Fig. 2 *(Left)* Variations in detail of method of suspending stressed-skin panels on main frame of roof

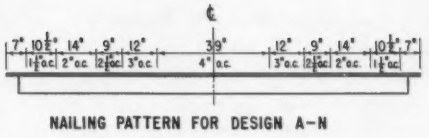
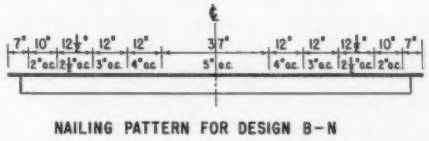


Fig. 3 *(Right)* Pattern of nailing plywood cover to each longitudinal in stressed-skin panels with nailed-on covers



out slippage. When a plywood skin is used, there is possibility of rolling shear failure between the face and cross bands.

The possibility of buckling of the skin when spacing between the longitudinals is excessive should be considered. For stressed-skin panels with plywood covers, the Douglas Fir Plywood Association (1)* developed recommendations for the proportion of the cover to be considered in computing the section properties. These recommendations took into account the longitudinal spacing.

One requirement that has been implicit in recommended design procedures for plywood stressed-skin panels is that the panel should have a cover on both faces. It appeared at the outset of the present study that a panel with a cover on only one face had advantages for certain applications with relatively light loads. Elimination of the bottom cover permits use of a modular panel supported by ledgers on the main roof frame. A panel with top and bottom covers would require one of the following alternative erection procedures:

(a) Support the panel on the upper edge of the main roof frame using relatively long fasteners to penetrate through the panel into the roof frame.

(b) Support the panel on ledgers. This would result in a wide seam between the panel ends, and require a center-to-center spacing of the main roof frames different from the panel over-all length.

(c) Use a full-size sheet for the upper cover, but trim the lower cover to permit the panel to nest between the main frames as in one of the methods of Fig. 2.

None of these alternatives would appear to achieve the simplicity in application obtained with a single cover panel installed by one of the methods in Fig. 2. A single-cover panel need not be turned over during fabrication. Also, dimensional irregularity in the longitudinals when undressed lumber is used is somewhat easier to overcome in a single-cover panel. A single-cover panel can be bent readily to the curvature of a glue-laminated arch frame during installation of the panels. This would be difficult with a double-cover panel because of its greater transverse stiffness.

Loading Experiments and Results

Flat Panels, Plywood Skin. Gravity loading experiments were conducted to measure the stiffness factors of two variations of a panel thought to be typical and suitable for farm-building roof construction. The design is illustrated in Fig. 1. The variations were in longitudinal size. Design A employed dressed, kiln-dried 2-in. by 4-in. Douglas fir longitudinals. Design B used undressed 1-in. by 6-in. southern yellow pine with a moisture content of 9.5 percent. Three replications each of these designs were constructed with the cover bonded to the longitudinals with casein glue (designated, G); and three with a nailed-on cover (designated, N), for a total of twelve panels. The nailing patterns for designs A-N and B-N, respectively, are illustrated in Fig. 3. Nails used were 8d common nails for design A-N, and 6d cement-coated for design B-N. Designs A-G and B-G employed 6d cement-coated nails 4 in. on center to provide clamping pressure until the adhesive hardened.

The panels were test loaded with gravity loads applied at the third points. Micrometer dial indicators were mounted to bear on the panel surface with one dial over each longitudinal at midspan, to provide four deflection readings at each load increment. The panels were supported on the end headers at a center-to-center spacing of 11 ft 2¼-in. The loading procedure consisted of applying 150-lb load increments evenly distributed transversely at each third point. Fifty-pound concrete blocks, 8 in. by 8 in. by 16 in., were used for loading.

TABLE 1. STIFFNESS FACTORS FOR FLAT STRESSED-SKIN PLYWOOD PANELS WITH SINGLE COVERS, AS DETERMINED BY LOADING EXPERIMENTS.

(NOTE: Refer to Fig. 1 for basic panel design and to Fig. 3 for cover nailing patterns. Total panel load of 1500 lb at third points.)

	Stiffness factor, EI — lb-sq in. x 10^6			
	Panel design			
Panel replication	A-N	A-G	B-N	B-G
1	64.7	84.5	154.1	205.9
2	60.2	75.4	166.3	208.3
3	69.4	88.0	158.7	205.0
Average	64.8	82.6	159.7	206.6
Relative stiffness	1.00	1.27	2.46	3.19

The results of the load-deflection experiments are tabulated in Table 1. The stiffness factor, *EI*, was computed from the standard expression for deflection of a member under two equal point loads symmetrically spaced.

An experiment was conducted on longitudinal-strain variation in the upper fibers of the cover due to differences

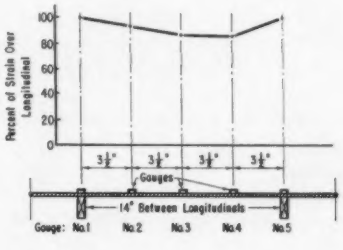


Fig. 4 Variation of longitudinal bending strain with transverse position on cover of stressed-skin panel

*Numbers in parentheses refer to the appended references.

in position along a transverse line approximately one foot from one loading point and 3 ft from the other. Ideally, fiber strain should be equal at all points along a transverse line. Actually the strain varied as shown in Fig. 4 due to non-uniform longitudinal bending of the cover. The strain measurements were obtained at 1500 lb total load with SR-4 gages in the positions indicated and oriented to respond to longitudinal strain.

Bowed Panels with Plywood Cover. Application of stressed-skin panels to a curved frame requires transverse bowing of the panels. Theoretical analysis indicated that the stiffness of a bowed or curved panel was greater than a flat panel of the same design, at certain values of radius of curvature and longitudinal spacing.

An experimental study was conducted to evaluate the relative stiffness of curved compared to flat panels. The basic panel was a 4 ft by 8 ft by ⅜ in. exterior type, grade A-C Douglas fir plywood cover glued to "Standard" grade, dressed, 2 in. by 4 in. Douglas fir longitudinals. The variables which appeared to be pertinent to the study included:

	Dimension
Φ, deflection ratio = deflection of curved panel / deflection of flat panel	—
ρ, radius of panel curvature	L
w, panel width	L
s, panel span	L
t, panel thickness	L
h, longitudinal spacing	L
d, longitudinal depth	L
b, longitudinal thickness	L

These were combined to form seven dimensionless parameters, as follows:

$\pi_1 = \Phi$ $\quad$ $\pi_5 = d/w$

$\pi_2 = w/\rho$ $\quad$ $\pi_6 = t/d$

$\pi_3 = h/\rho$ $\quad$ $\pi_7 = b/d$

$\pi_4 = s/d$

The experiments were designed to evaluate the effect on π_1 of variations in π_2 and π_3. The other parameters were held constant at values corresponding to:

w = 48 in. (panel cover of 4 x 8-ft plywood sheet)

s = 92 in. (allowing 2-in. lip at each end of 8-ft panel)

d = 3⅜-in. (dressed two-by four)

b = 1⅝ in. (dressed two-by-four)

t = ⅜ in. (⅜-in. sanded, 3-ply plywood)

Longitudinals were symmetrically positioned at spacings, h, of 8, 12, 16, and 24 in. Three replications of each of these panel designs were built and load tested at radii of curvature including ∞, flat panel, 168-in., 120-in., and 96-in.

For the loading experiments, the panels were suspended on specially fabricated metal Z clips attached to each longitudinal end. These clips were hung on a 1⅝-in. thick rib at each panel end. The ribs were sawed to the radius of curvature at which the panels were to be tested. The panel was

Fig. 5 Equipment for applying load at third points and observing deflections at midspan of bowed, stressed-skin panels

bowed by nailing down the 2-in. plywood lip at each panel end to the rib. Load was applied at the third points by a double saddle of 1⅝-in. ribs with the same radius of curvature as the supporting ribs. The saddle carried a platform on which a load of weighed concrete blocks was placed to distribute one-half the total load to each third point. A general view of the loading equipment is shown in Fig. 5. Deflections were measured with micrometer dial gages at midspan over each longitudinal. Each panel was twice loaded to 700 lb and unloaded, then twice loaded to 1400 lb and unloaded. The results are given in Table 2. The values shown for Φ were computed as the average deflection of the curved panel for the two 1400-lb load applications divided by the average deflection of the corresponding flat panel for two 1400-lb load applications. Also shown in Table 2 are the theoretical values of Φ computed from the geometry of the flat and curved panels, respectively. The results are plotted in Fig. 6. The observed deflections for the flat panels are listed in Table 3. Each value is the average of two loading cycles of a 1400-lb total load on each of three panel replications for each longitudinal spacing.

Flat Panels with Asbestos Cement Cover. Asbestos cement flat sheets have durability and weather-resistance

TABLE 2. EFFECT OF CURVATURE ON STIFFNESS OF STRESSED-SKIN PANELS WITH SINGLE COVERS OF PLYWOOD

w/ρ (w=48 in.)	h/ρ	ϕ = Deflection ratio, curved panel deflection / flat panel deflection: Theoretical	ϕ: Measured by experiments
	0.0833	0.71245	0.9265
0.500	0.1250	0.76411	0.9236
(ρ=96 in.)	0.1667	0.82361	0.9276
	0.2500	0.97903	0.9562
	0.0667	0.80318	0.9586
0.400	0.1000	0.84791	0.9523
(ρ=120 in.)	0.1333	0.90058	0.9760
	0.2000	1.03124	0.9860
	0.0476	0.90472	0.9924
0.286	0.0714	0.93998	0.9784
(ρ=168 in.)	0.0952	0.97864	0.9939
	0.1429	1.07321	1.0106

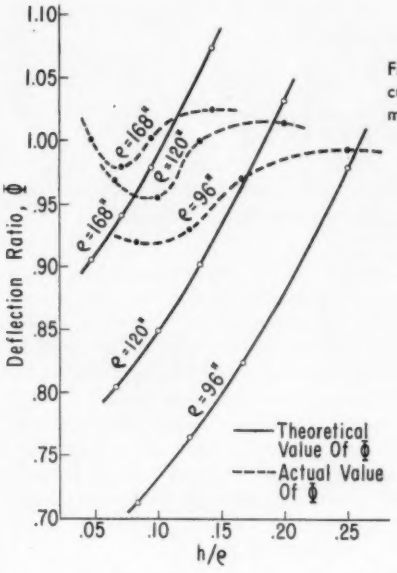


Fig. 6 *(Left)* Deflection ratios for curved stressed-skin panels determined by theoretical analysis and experimental measurement

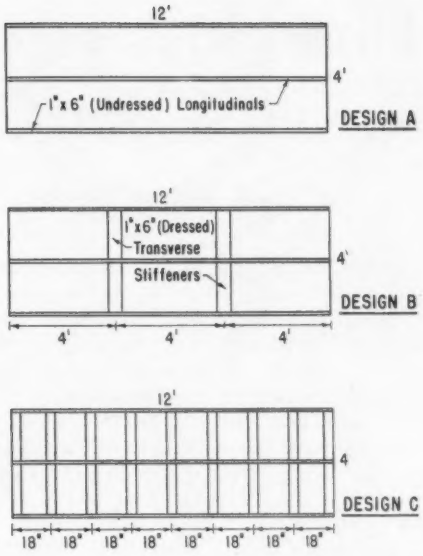


Fig. 7 *(Right)* Panel designs used in experiments on stiffness of stressed-skin panels with glued-on asbestos-cements covers

TABLE 3. STIFFNESS FACTORS AND DEFLECTIONS FOR FLAT, STRESS-SKINNED PANELS AS DETERMINED BY LOADING EXPERIMENTS

(Total load of 1400 lb at third points. Panels consisted of ⅜-in. by 4-ft by 8-ft Douglas fir plywood glue-nailed to 2 by 4-in. [dressed] Douglas fir longitudinals, symmetrically spaced)

Longitudinal spacing, *h*, in.	Stiffness factor, EI (lb-sq in. $\times 10^6$)	Average deflection at mid-span at 1400 lb, in.
8	159.7	0.120
12	125.5	0.152
16	107.6	0.178
24	80.8	0.237

qualities desirable in a cover for stressed-skin panels. Their brittle nature requires extra handling care and increases the susceptibility to hail damage, particularly in relatively thin sheets.

A limited experimental study was conducted to obtain design and performance data on stressed-skin panels assembled from 3/16-in. asbestos-cement flat sheets bonded with casein glue to undressed 1 x 6-in. southern yellow pine longitudinals. Design variations consisted of differences in spacing of transverse stiffeners, which were thought to be essential to reinforce the skin against breakage. Stiffeners consisted of dressed 1 x 6-in. members. The designs are diagrammed in Fig. 7.

Preliminary flexure experiments with samples to measure the modulus of elasticity of the asbestos cement yielded an average value of modulus of elasticity of 4.0×10^6 psi.

Since casein glue was to be used for bonding the sheets to the longitudinals, the strength in double shear of the adhesive bond between 3/16-in. asbestos cement and undressed southern yellow pine lumber was measured. A minimum shear strength in each shear plane of 291 psi was obtained. The average minimum value of tensile strength of the asbestos cement was found to be 1480 psi, based on the nominal sheet thickness of 3/16 in. Actual thickness was found to be 0.217 in., based on five measurements on each of three sheets. Based on ASTM specifications data cited by Murray (4), the minimum allowable moduli of rupture for 3/16-in. thick flat asbestos-cement sheets were estimated to be 1495 psi for Type I asbestos cement in flat sheets; 2135 psi for Type II, and 2700 psi for Type III. Type I is a general-utility, flat sheet; Type II is a rigid, high-strength sheet, and Type III is a flexible, high-strength sheet.

The calculated values for the basic panel design A illustrated in Fig. 7 were: for maximum shear in the glue line, 70.7 psi; for maximum bending stress, 1022 psi in the wood and 711 psi in the asbestos cement due to longitudinal bending, and 1272 psi in the asbestos cement due to transverse bending, all for a uniformly distributed superimposed load of 20 lb per sq ft.

The values of the panel stiffness moduli were determined by applying concentrated loads at the third points of each panel and measuring deflection at five points at mid-span with micrometer dials. One dial was situated over each longitudinal and one midway between each pair of longitudinals. The stiffness factors, based on the slopes of the load-deflection graphs, are given in Table 4. The computed stiffness factor, based on a modulus of elasticity of wood of 1.76×10^6 and of asbestos cement of 4.0×10^6, longitudinals 1 in. by 6 in., and asbestos cement sheet thickness of 0.217 in., actual was 127.2×10^6 lb-sq in.

Building Erection with Stressed-Skin Panels

Three different shelter buildings were erected with stressed-skin panels to obtain experience and data that would be of help in developing appropriate practices for applying stressed-skin panels. These buildings included an umbrella-frame utility shelter with flat stressed-skin panels with ply-

(Continued on page 697)

TABLE 4. EXPERIMENTALLY DETERMINED STIFFNESS FACTORS FOR FLAT STRESSED-SKIN PANELS OF 3/16-IN. ASBESTOS-CEMENT ON 1-IN. BY 6-IN. UNDRESSED LONGITUDINALS

(Refer to Fig. 7 for panel designs. Panels loaded to a total of 1500 lb, half at each third point.)

Design	(lb-sq in. $\times 10^6$) EI	stiffness Relative
A	154.0	1.00
B	182.4	1.18
C	177.0	1.15

Fiberglass as a Filter for Closed Tile Drains

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Research study shows material functions well in most unstable soils

THE use of sand and gravel envelopes or filter materials around tile drains has long been recommended in the irrigated areas of western United States to facilitate water entry and prevent soil from entering the tile drainage system. The increasing need for greater economy in drainage continues to require the use of adequate but inexpensive filter materials. Sand and gravel materials have been widely used with costs usually ranging from 25 to 65¢ per lineal foot. Recently fiberglass materials have become available commercially at a price of less than 5¢ per foot. Obviously the savings would be tremendous in view of the amount of tile installed each year if it could adequately replace conventional envelope materials.

The purpose of the research results reported in this paper was to determine what soil sizes would not move through the fiiberglass material into the tile line. In addition, a brief examination has been made of the material's strength to withstand the shock loadings during backfilling. Initially the longitudinally reinforced fiberglass mat was examined; however, work was extended to an improved material containing random reinforcing fibers (see appendix).

PROBLEM ANALYSIS

Forces Causing Particle Movement

The factors tending to cause particle movement and their relative importance should be examined. This requires analysis of the forces causing particle movement and its interaction with particle size, arrangement, and shape. The forces are best described by an example.

If sand and water are placed in a cylinder with a solid bottom, the total force on the bottom will be the sum of the independent weights of sand and water. Since the sand is immersed in water, there is a buoyant force tending to reduce the particle weight, giving a resultant weight which might be called a submerged or buoyant particle weight. The force on the cylinder bottom would be equivalent to the hydrostatic pressure transmitted undiminished by the water through the sand to the bottom plus the submerged or buoyant weight of the sand carried to the bottom through partial contact between soil particles.

If the solid bottom of the cylinder is replaced by a screen and water is supplied at the top at the same rate as it escapes by seepage from the bottom, obviously the force on the screen must remain equal to the contents of the cylinder; and yet no part of this load is transmitted to the screen by static hydraulic pressure as before. It is exerted entirely through the solid material, with the downward water movement tending to further increase the effective particle weight. If flow had been upward through the cylinder with higher and higher velocities, ultimately the upward force would equal or exceed the buoyant particle weight resulting in particle instability and movement.

Accordingly, if the soil is a coarse sand or gravel, the forces of flow are small in comparison with the buoyant particle weight resulting in stable soils. However, for smaller particle sizes (very fine sand and silt) the flow forces can move the soil particles causing the common tendencies of instability in these size ranges. Instability or piping tendencies would become progressively worse for fine silts and clays were it not for the appearance of interparticle forces which bind individual particles together. Therefore, consistent with practical experience, the most difficult group of soils in preventing particle movement lie in a range between 0.05 and 1.0 mm.

Experimental results in the sedimentation field clearly show the dependence of stability on particle size. Greater resistance to movement would be expected in porous media than for particles exposed to erosion in open channels. Therefore, sedimentation data should represent a very conservative condition for flow in porous media. Fig. 1 presents data from Dunn (3)* showing the critical tractive force which must be exceeded in order for particle movement to occur on canal banks as a function of particle size. This indicates that the intermediate sizes will move at lower values of tractive force.

Sherard (6), in another study, inventoried earth fill dams with respect to particle movement or piping and

*Numbers in parentheses refer to the appended references.

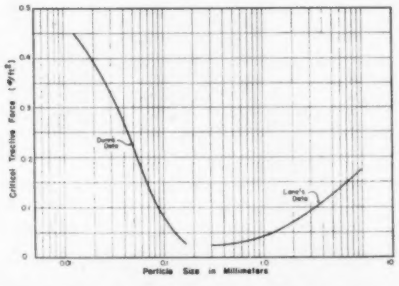

Fig. 1 Critical tractive force required to cause particle movement in canals [Redrawn from Dunn (3)]

Paper prepared expressly for publication by the American Society of Agricultural Engineers, as a contribution of the Soil and Water Conservation Research Division (ARS), USDA, in cooperation with the Colorado Agricultural Experiment Station.

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Acknowledgment: The contribution of the fiberglass materials by the mat division of the Libbey-Owens-Ford Glass Fibers Co. is gratefully acknowledged, including the help of M. W. Gregory, sales manager. The author also wishes to express appreciation to D. L. Miles, engineering student trainee, Agricultural Research Service (USDA), for the fine manner in which he carried out the experimental work.

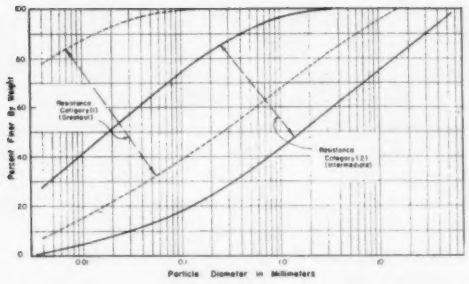

Fig. 2 *(Left)* Influence of gradation on resistance to piping [Redrawn from Sherard (6)]

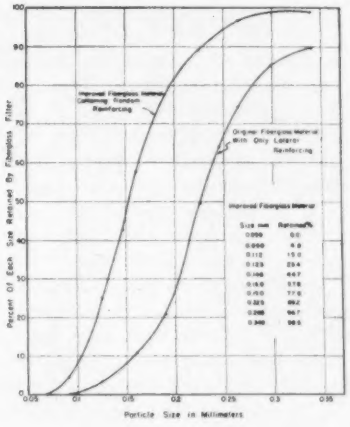

Fig. 3 *(Right)* Size retention characteristics for fiberglass filters

formed three resistance categories based upon the severity of seepage and the degree of damage to the embankment. The three piping resistance categories were then correlated with the soil properties of the fill material. Fig. 2 shows the range of particle sizes covered by the resistance categories with category 1 exhibiting greatest resistance to piping. Sherard further found these categories to be related to the plastic index (P.I.) of the embankment material as follows:

Greatest piping resistance (category 1)	P. I. $>$ 15
Intermediate piping resistance (category 2)	$6 <$ P.I. < 15
Least piping resistance (category 3)	P.I. < 6

These data corroborate the earlier discussion and indicate that very fine soils probably do not require a filter material to inhibit soil movement. Also, Laursen (4) showed by studying sediment transport in circular conduits that material 0.05 mm or smaller will seldom form long-term deposits in properly installed drainage systems. This is fortunate since filter materials fine enough to stop very fine soils would be subject to clogging which would hamper the over-all functioning and efficiency of the drain.

These data indicate that soil particles smaller than 0.05 mm do not require the use of filter materials around buried drains to prevent their entry. This is a result of *(a)* the interparticle forces as exhibited in cohesion result in sufficient stability to inhibit movement, hence, progressive failure will not occur, and *(b)* material this fine can be transported from a properly installed drain thereby preventing reduction in carrying capacity by long-term sediment accumulation. (NOTE: Additional research and experience may justify raising the 0.05 figure to about 0.1 mm; however, at present there is insufficient data to allow use of the higher value.)

Effect of Particle Arrangement and Shape Upon Movement

The effect of particle shape upon preventing movement was studied by Bertram (1). He found that Ottawa sand when used as a filter allowed a movement of 5 percent by weight as compared to 3 percent for crushed quartz under the same test conditions. These data indicate some differences due to particle shape; however, there is not enough information nor are the differences large enough to indicate it is a primary factor. In the same study Bertram showed that filter compaction was of only minor importance. He did specify that the conclusions were only applicable to filters at least 50 percent compacted as defined by Terzaghi. It would be unlikely for even backfill material around tile to be below 50 percent compaction under usual installation conditions.

Results of Bertram's work show particle shape and degree of compaction to be second or third order effects as compared to the distribution of soil particle sizes. Accordingly the gradation or mechanical analysis curve for soils was used as the basis for determining the adequacy of the fiberglass in preventing soil movement.

EXPERIMENTAL RESULTS AND DISCUSSION

Determining Filtering Ability

To determine what particle sizes physically would not move through the fiberglass material, a jet of water was used to agitate and move the soil particles through the material. Such a procedure may seem severe by completely ignoring any bridging of soil particles or the development of a natural soil filter. However, this procedure does give the sizes which correspond to the openings in the fiberglass material.

A fine sand-silt subsoil underlying Grandview silty clay loam (Idaho) was used to determine the fiberglass opening size. The size of openings was found by measuring what soil particle sizes were washed through the fiberglass. Initially approximately 10-gram samples were washed through fiberglass disks placed in the top of a nest of 1.0, 0.5, 0.1, and 0.05 millimeter sieves. All the material less than 0.05 millimeter passed through the fiberglass and small amounts of mica present tended to cause erratic results. The mica and material finer than 0.05 millimeter were subsequently removed from the remainder of the samples. It became apparent that *(a)* the fiberglass was not uniform with respect to filtering properties, and *(b)* the filtering properties became poor somewhere between 0.1 and 0.25 mm. Item 1 was anticipated since the material is a non-woven fabric.

The second series of tests were more comprehensive using soil particles ranging from 0.05 to 0.5 mm. Sufficient tests were combined to give samples large enough for standard mechanical analysis. The material passing through the fiberglass was subdivided into ten sizes in the 0.05 to 0.5 mm range. A summary of the results is shown in Fig. 3 for both of the fiberglass sheets tested. This curve is not a standard particle-size distribution curve as the ordinate labeling and general curve shape might suggest. The ordinate is expressed as the percent *of the amount of that par-*

ticular size present which was retained by the fiberglass. For example, suppose that a 100-gram sample of soil contained 5 grams of soil with a particle size of 0.2 mm, then the percent retained as taken from the curve for the improved material would be 81.5 percent, or 4.1 grams would not pass through the fiber glass under similar test conditions. The curves show what soil particles would pass through on the average for a given length of the fiberglass material rather than at a specific point.

The improved material has finer and more uniform openings as indicated by the curve being displaced to the left in Fig. 3. In both cases there was always a few particles that would pass through. However, in the case of random reinforced fiberglass the percent retained reached 98.5 percent, whereas the original material containing longitudinal reinforcing reached approximately 90 percent as a maximum. As will be subsequently discussed, the fiber material containing only longitudinal reinforcing also had insufficient lateral strength. Hence, this material was considered inadequate and only the improved material containing random reinforcing fibers will be discussed further with regard to filtering properties.

Stability Criteria

The data obtained were used to develop workable criteria for examining field soils to determine whether the improved fiberglass sheet would provide adequate protection. The fiberglass sheet was considered as being analogous to a well screen having variable slot openings. Criteria for well screens as presented by the Corps of Engineers (7) is

$$\frac{D_{85}}{\text{opening size}} \geq 1.0$$

where D_{85} is the particle diameter corresponding to 85 percent finer on the mechanical analysis curve. The author (5) has used this criteria in very unstable material and found it to initially allow some material to enter, yet in no case was there progressive failure even when the ratio became as great as 1.8. Similar experience with water wells has been presented by Briggs (2) where some soil movement occurred when the D_{85} ratio was used, yet the movement did not result in progressive failure. On the other hand, Briggs suggested a more conservative criteria which minimizes sand movement as:

$$\frac{D_{50}}{\text{opening size}} \geq 1.0$$

This relationship states that the 50 percent size shall be greater than or equal to the average diameter of opening in the screen. This conservative criteria is recommended for general use with fiberglass filters.

To use the criteria an effective size of opening in the fiberglass was determined from the data shown in Fig. 3. This was accomplished by using the distribution curves (Fig. 4) of a well-graded soil and a uniform very fine sand. Both soils are in the range of greatest instability as shown by Dunn's data (Fig. 1). Utilizing these two soils and the results shown in Fig. 3, the amounts and particle sizes that would pass through the fiberglass were determined, and plotted as dashed curves in Fig. 4. Various values for the 50 percent size (D_{50}) were assigned for these same two distribution curves and Fig. 3 again used to determine the percentage of the hypothetical soils that would be retained by the fiberglass.

The dashed curves show the amount passing through the fiberglass, expressed both in percent of total passing and in percent of the entire sample. The percent at which the shorter curve (percent based upon original sample size) becomes horizontal represents the percent which could be forced through the fiberglass by a water jet. Closer examination of Fig. 4 shows that a little more than 50 percent of the two soils passed through the fiberglass. Therefore, successive reductions in the assumed D_{50} size for the particle distribution resulted in 50 percent of the material being retained. Assuming these two materials to represent the expected range in soil gradation, Fig. 5 was constructed. The curve separating the zones of satisfactory and unsatisfactory protection was obtained by joining the upper half of the gradation curve for the uniform distribution to the curve for the wide distribution lying below the 50 percent size.

Fig. 5 provides an easy method for determining whether the filter is adequate for any particular soil by noting into which category the mechanical analysis falls for the soil being examined. In any particular case should the field engineer desire to use more lenient criteria, such as the Corps of Engineers' specifications, the soil can be examined through use of Fig. 3 to plot curves similar to those shown in Fig. 4.

The criteria (Fig. 5) can be compared with the work of Dunn (3) and Sherard (6) as presented earlier. When comparing Figs. 2 and 6, or Sherard's data, with the criteria for the improved fiberglass material, it is seen that many of the problem soils encountered in the field could be adequately prevented from moving. Fig. 6, showing Dunn's data with the developed criteria superimposed, again indicates that the material would give protection against movement down to the critical size range.

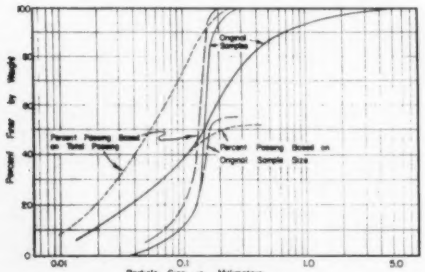

Fig. 4 *(Left)* Soil movement through improved fiberglass

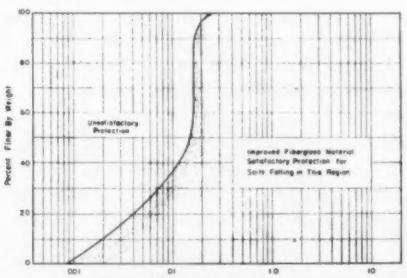

Fig. 5 *(Right)* Soil filtration criteria for improved fiberglass

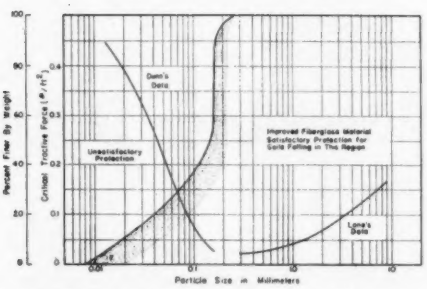
Percent Finer By Weight
Critical Tractive Force (P/ft²)
Particle Size in Millimeters
Dunn's Data
Unsatisfactory Protection
Improved Fiberglass Material Satisfactory Protection For Soils Falling in This Region
Lane's Data

Fig. 6 Comparison of filtration criteria with Dunn's work on tendency for particle movement

Strength of Fiberglass

A brief study was made of the material's strength to withstand the impact loadings during backfilling of the draintile. This cursory examination consisted of tensile tests based upon ASTM methods and direct wet sand impact tests on fiberglass strips laid over different types and sizes of tile.

The tensile tests were on the standard Scott testing machine for fabrics in accord with ASTM standards for non-woven material. The results of these tests on 4-by-6-in. samples are summarized in Tables 1 and 2.

These data indicate that the original longitudinally reinforced material is inferior to the improved product due to lack of strength in the lateral direction. This combined with the poor filtering characteristics found earlier would make original material unsatisfactory for general use. Accordingly, only the improved fiberglass was used in the backfill impact tests.

The backfill impact tests consisted of successively placing different tile in a simulated trench, laying a fiberglass sheet over the tile, and dumping wet sand from a fork-lift truck at heights of 7 to 8 ft. The drain tubes used included 6-in. concrete bell and spigot, 6-in. concrete butt joint, 4-in. bell and spigot, 4-in. butt joint clay, and 4-in. hexagonal clay tile. Qualitative observation of the success or failure was taken after each test.

In general, excessive breakage of the fiberglass occurred at the joint for bell and spigot tile. Part of the time the fiberglass would be cut along the sharp outer edge of the bell, letting the fiber fold down to form a very satisfactory filter across the joint. However, at other times general breakage and tearing would result in practically no filter protection at the joint. On one test with belt-and-spigot tile, failure occurred about 2 in. back along the tile from the bell allowing the fiber to fold around the crack. This suggested cutting the fiberglass 2 to 4 in. above the bell, thereby causing failure where no harm results and allowing the fiberglass to fold down over the joint. Upon further examination, this procedure practically eliminated breakage at the joint, but it does require additional labor.

When butt joints were examined, the material failed far less frequently, yet misalignment did occasionally cause breakage. When wide strips were laid on top of the tile, there was a tendency for longitudinal tearing as the backfill material forced the fiberglass around the lower part of the tile. A 15-in. strip was found to be optimum for a 4-in. tile and practically eliminated this tearing. A 22 to 24-in. width was found to result in little or no longitudinal tearing for 6-in. tile.

TABLE 1. TENSILE STRENGTH OF ORIGINAL FIBERGLASS MATERIAL WITH LONGITUDINAL REINFORCING

Direction of stress and test run		Breaking strength, lb	Elongation, in.	Comments
Lengthwise	1	11.0	0.1	
"	2	2.0	0.1	
"	3	1.0	0.1	
"	4	6.0	0.1	
"	5	7.0	0.1	
Average		5.4	0.1	
Crosswise	1	0	0	Insufficient strength to obtain a measurement in lateral direction
"	2	0	0	
"	3	0	0	
"	4	0	0	
"	5	0	0	
Average		0	0	

TABLE 2. TENSILE STRENGTH OF IMPROVED FIBERGLASS MATERIAL

Direction of stress and test run		Breaking strength, lb	Elongation, in.	Comments
Lengthwise	1	4.0	0.05	Padding used in testing machine jaws
"	2	6.5	0.05	
"	3	10.0	0.05	
"	4	9.0	0.10	
"	5	10.0	0.10	
Average		7.9	0.07	
Crosswise	1	2.0	0.10	Padding used in testing machine jaws
"	2	2.0	0.10	
"	3	2.0	0.10	
"	4	10.0	0.10	
"	5	5.5	0.05	
Average		4.3	0.09	

With the exception of a rare failure with bell-and-spigot tile, breakage and tearing of the fiberglass was found to be eliminated by manually covering the fiberglass with from 2 to 4 in. of soil. Care is required during hand blinding to prevent rocks from being thrown against the fiberglass since it has little resistance to abrasion.

Upon completion of the impact tests on sheets laid over tile, consideration was given to what size holes and slots might be covered with the improved fiberglass material bonded to the drain tube. Such a procedure through better utilizing the fiberglass strength might enable it to withstand backfilling without prior hand blinding. A series of slots in ½, ⅜, ¼, and ⅛-in. widths were constructed from wood. The randomly reinforced material was fastened over the slots by gluing the fiberglass to the wood. Wet sand was dropped from a height of 8 ft several consecutive times before a slight break appeared in the ½-in. slot. Similarly holes of 1/16, ⅛, 3/16, ¼, 5/16, ⅜, ½, and ⅞-in. diameter were examined. After several successive drops of sand from an 8-ft height, the material was completely unharmed over all the hole sizes examined. This test indicates that the fiberglass could be utilized most efficiently by bonding it to a drain tube which contained holes or slots to allow water entry. Such a procedure not only would better utilize the strength of the material, but also would result in saving labor during installation.

(Continued on page 700)

Improved Procedures in Grassed Waterway Design

C. L. Larson and D. M. Manbeck
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ROUGHNESS or retardance can be considered a constant in designing many types of open channels. With grassed waterways, however, Ree and Palmer (1)* have shown that the roughness coefficient, n, in the Manning formula varies a great deal with the type and length of grass and depth of flow. Their experiments showed that n is often 50 to 100 percent higher than had been usually assumed for grassed waterways.

In a later publication (2), Ree divided the various grasses used in grassed waterways into five retardance classes, A, B, C, D, and E, according to the species and length of grass. He also presented permissible velocities, which vary with the species of grass, the waterway slope and the erodibility of the soil. Almost invariably, the permissible velocity is a limiting factor in designing grassed waterways.

The roughness coefficient was originally (1) related to a factor VR, V being the mean velocity and R the hydraulic radius. In the second bulletin (2), Ree developed a more convenient form for the retardance data. For each retardance class a chart was drawn giving solutions of Manning's formula, taking full account of the variation in retardance with velocity and hydraulic radius. Three of these charts and the related information have been reproduced in the textbook by Frevert *et al* (3).

The excellent data obtained by Ree and Palmer have been used in some areas but, to date, have not been put into practice throughout the United States. One reason, perhaps, is the fact that another variable (retardance) is added to the typical design problem. However, the retardance charts previously referred to take care of this problem by giving a direct answer for the required hydraulic radius. Thus there is little reason for not making use of the variable retardance data.

For a proposed waterway, the flow area is readily calculated from the design discharge and the permissible velocity. Knowing the area and the hydraulic radius, it remains to select a cross section which will satisfy both of these requirements. This step requires either a trial-and-error solution or the use of additional charts (2). One major purpose of this paper is to present some techniques for simplifying this process.

Another important consideration in designing grassed waterways is the length of the grass. It may be recently mowed, in which case it gives minimum retardance and allows maximum velocity. Thus in determining the relative channel dimensions one must assume a short grass condition in order to avoid excessive velocities. However, the design discharge may just as well occur at a time when the grass is long. Due to the higher retardance, the mean velocity would then be less than designed for and the depth of flow would be greater. Sufficient depth must be provided for this condition.

The second objective of this study was to develop criteria for determining over-all depths for grassed waterways. Investigation showed that the increase in depth due to long grass conditions varies considerably. It is therefore evident that a fixed amount of freeboard, as commonly used, is not suitable for all conditions.

Simplified Design Procedures

Three types of cross sections are used for grass waterways: triangular, parabolic, and trapezoidal. Equations for the hydraulic elements of the three types of cross sections are given in reference (3). Considering first a triangular section, we see that the hydraulic radius, R, is expressed by

$$R=\frac{zd}{2\sqrt{z^2+1}}$$

where z:1 is the sideslope ratio and d is the depth of flow. The factor z should be at least 6 for a triangular waterway and is often considerably greater. In the above expression, as z becomes large, $\sqrt{z^2+1}$ approaches z, and R approaches $d/2$. Thus it appears that $d/2$ will serve as a satisfactory approximation for the hydraulic radius of triangular grassed waterways.

The hydraulic radius of a parabolic waterway is given by

$$R=\frac{2t^2\ d}{3t^2+8d^2}$$

where t is the top width at the water surface. As t becomes large in relation to d, $8d^2$ becomes insignificant, and R approaches $\frac{2}{3}\ d$. Thus $\frac{2}{3}\ d$ appears to be a satisfactory approximation for the hydraulic radius of a parabolic grassed waterway.

Numerous calculations were made to test the accuracy of these approximations. Percent error was determined from the difference between the exact and approximate values of $R^{2/3}$, which is proportional to velocity (and discharge). The results of these calculations for triangular and parabolic waterways of minimum width are given in Table 1. The minimum widths are based on two and three swaths, respectively, with a 7-ft mower. In each case, three side slope ratios commonly used are given. Minimum width and maximum side slope ratios were used to determine the maximum possible error with established practices.

These results show that the error caused by using the above approximations is usually less than one percent, which can be considered insignificant. For the 4:1 triangular waterway, the error is somewhat greater, but this side slope ratio is impractical for triangular waterways because of the difficulty of crossing with machinery. In a majority of waterways, the widths will be greater and the side slopes

Paper presented at the Winter Meeting of the American Society of Agricultural Engineers at Chicago, Ill., December 1959, on a program arranged by the Soil and Water Division. Approved for publication as paper No. 4286, scientific journal series, of the Minnesota Agricultural Experiment Station.

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*Numbers in parentheses refer to the appended references.

TABLE 1. PERCENT ERROR IN VELOCITY DUE TO USE OF APPROXIMATIONS FOR HYDRAULIC RADIUS OF MINIMUM WIDTH WATERWAYS

Type and width	Side slope ratio	Depth, ft	Approx. R	Exact R	Percent error
Triangular (13 ft)	4:1*	1.625	0.812	0.788	2.04
	6:1	1.083	0.542	0.534	0.92
	8:1	0.812	0.406	0.403	0.52
Parabolic (20 ft)	4:1†	1.250	0.833	0.825	0.69
	6:1†	0.833	0.555	0.553	0.31
	8:1†	0.625	0.417	0.416	0.17

*Not recommended for triangular waterways.
†Side slope ratio at edge of waterway=$t/4d$.

flatter than those tabulated, and the error correspondingly less.

The above approximations enable one to make a direct solution for the depth and width of any triangular or parabolic channel of shallow depth. The procedure in a typical waterway design problem, when the slope and the design discharge are known, is as follows:

1 Select species of grass and permissible velocity. Determine retardance class for mowed condition.

2 Refer to appropriate retardance chart, using slope and velocity, to find required hydraulic radius.

3 Calculate required area, $A=Q/V$.

4 Choose between a parabolic or triangular section. If parabolic, calculate $d=\frac{3}{2}R$; if triangular, calculate $d=2R$.

5 Calculate top width from following expressions for area of cross section: $A=\frac{2}{3}td$ for parabolic waterway; $A=\frac{1}{2}td$ for triangular waterway.

6 Compare top width to depth to see if proportions are practical. If width is too small, redesign with lower velocity.

7 Determine over-all depth and top width (discussed below).

Ree has developed charts for steps 4 and 5 which also eliminate trial and error solutions. The approximations are offered here as an alternative method for those who do not have access to reference (2), and are suggested for teaching purposes in conjunction with reference (3).

With trapezoidal grassed waterways, there is no simple relation between R and d which would serve as an approximation. A new type of chart was developed to relate the four main elements of a trapezoidal cross section—depth, bottom width, area, and hydraulic radius. A chart of this type, for 4:1 side slopes, is given in Fig. 1. A wide range of bottom widths is shown so that the chart can be used for grassed waterways, diversions, and emergency spillways.

The procedure for designing a trapezoidal grassed waterway is identical to that for a parabolic or triangular waterway through step 3. Referring to Fig. 1, the values of A and R already determined will establish the design point on the chart. Values for the bottom width, b, and depth of flow can then be read directly from the appropriate scales. For example, if $A=24$ sq ft and $R=0.60$ ft, the depth of flow should be 0.64 ft and the bottom width 35 ft.

Over-all Depth Requirements

As outlined above, relative channel dimensions must be determined for a mowed grass condition. To complete the design, one should then determine the depth of flow that will occur at design discharge in the same channel with a

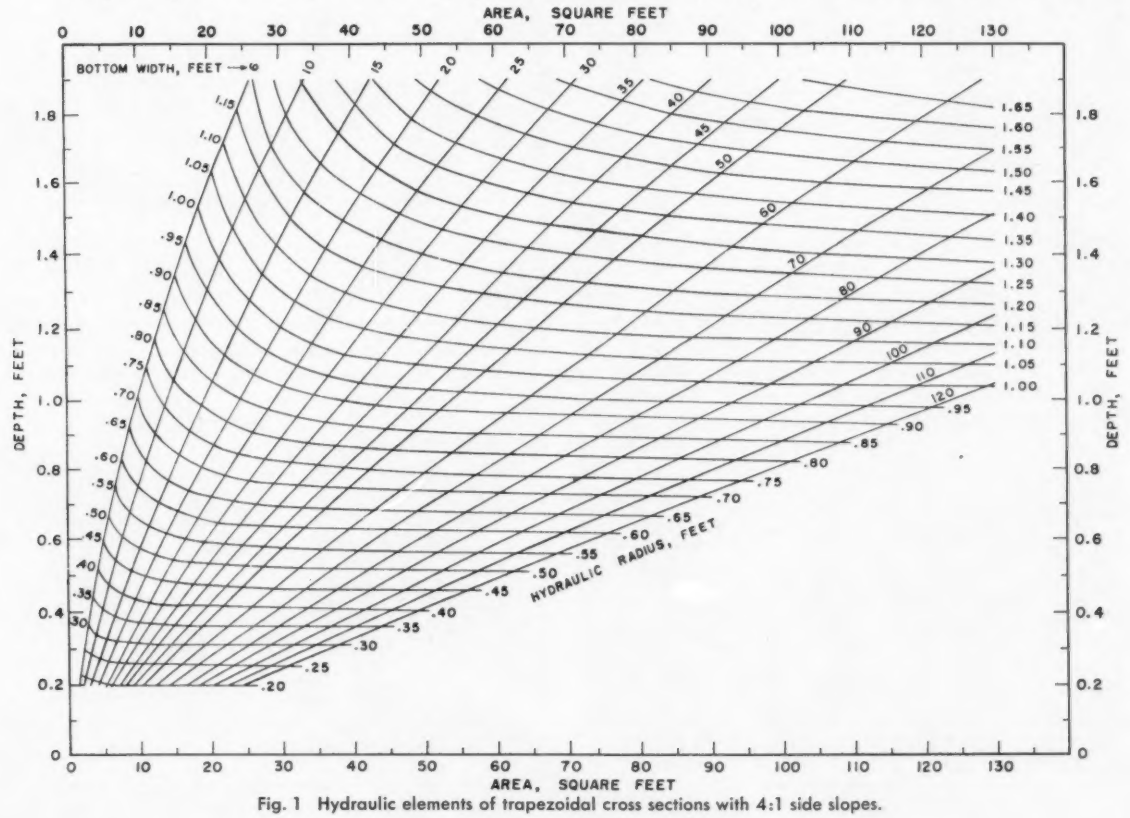

Fig. 1 Hydraulic elements of trapezoidal cross sections with 4:1 side slopes.

long grass condition. The depth of flow and the flow area will increase and the mean velocity will decrease. Because all these factors change, and since the relation between width and depth has already been fixed, a trial-and-error solution is necessary to determine the actual depth of flow. In doing this, approximations for R and the charts are helpful, but a trial solution cannot be avoided.

To determine the increase in depth due to long grass conditions, numerous solutions of this type were made as a part of the study. This increase in depth is subsequently referred to as "retardance depth". Values of the retardance depth were determined for the three types of cross sections, for five slopes from 1 to 15 percent and for three design velocities. Since most grasses fall in classes B, C and D, only these classes were used in the analysis. Factors found to affect the retardance depth are the percent of slope, design velocity, the change of retardance classes and the shape of the cross section.

The principal results of this phase of the study are given in Figs. 2, 3 and 4 for triangular, parabolic and trapezoidal cross sections. The upper curve(s) in each figure shows retardance depth for grasses which are in class C when mowed and in class B when long. The lower curves are for grasses which are in class D when mowed and in class C when long.

For the change from C to B, the effect of velocity was relatively small. Therefore, a single curve was drawn in each case, using maximum retardance depths for the three velocities used in the study. For trapezoidal waterways, two upper curves were drawn to show the effect of bottom width on retardance depth. Values for a 20-ft bottom width are not shown but were computed and found to be approximately midway between the 6 and 90-ft values.

For the change from class D to C, the retardance depth was found to vary only slightly with slope. The effect of velocity, however, was considerably greater than for the upper curves. Hence, a separate curve was drawn for each velocity.

A careful inspection of Figs. 2-4 shows that the discrepancy between the points and the curves as drawn varies from -0.01 to $+0.05$ ft. In most cases, however, the discrepancy is from zero to $+0.03$ ft. Thus, when using these curves for design, any error of this origin usually causes a slight overdesign.

Certain grasses change two classes as the grass attains full growth. The retardance depth for the change from class D to class B can be approximated by adding the two retardance depths shown in Figs. 2-4, i.e., class D to C plus class C to B. Comparative solutions showed that the error resulting from this method varies from -0.01 to $+0.12$ ft, but in most cases it is from zero to $+0.06$ ft.

A small amount of freeboard, say, 0.1 to 0.2 ft, may still be added, if desired, to allow for silt deposition or other factors. The authors believe, however, that this method will enable one to make a more accurate determination of the total additional depth required. The total depth, d, for a grass waterway is, therefore, the depth of flow for the mowed condition, plus the retardance depth, plus the freeboard, if any.

The total top width, T, of a waterway depends on the total depth and the type of cross section. For a triangular cross section the top width is directly proportional to the depth. The top width of a parabolic cross section is proportional to the square root of its depth. For a trapezoidal cross section, the top width equals the bottom width plus twice the product of the side slope ratio and the depth.

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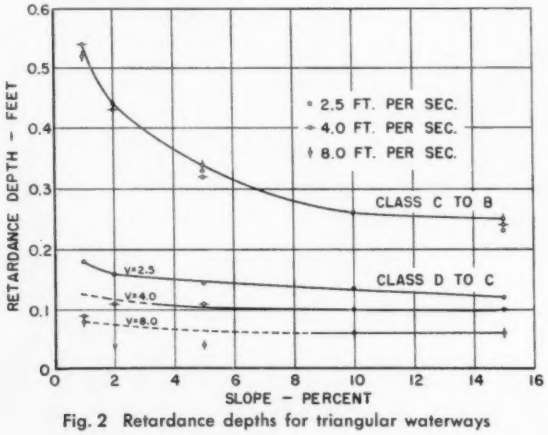

Fig. 2 Retardance depths for triangular waterways

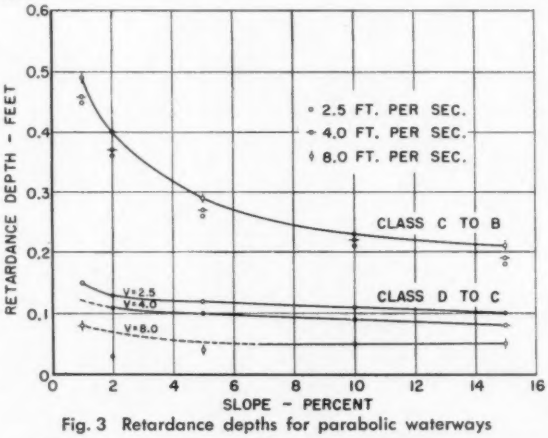

Fig. 3 Retardance depths for parabolic waterways

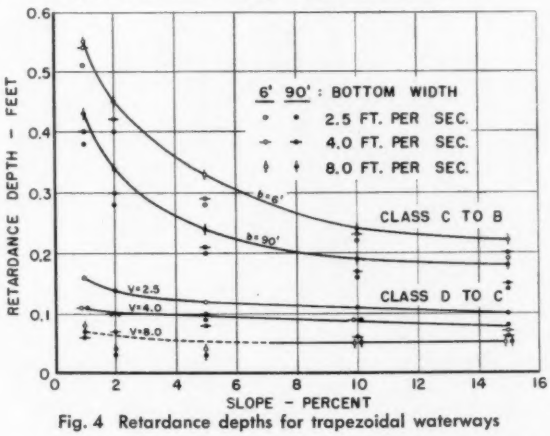

Fig. 4 Retardance depths for trapezoidal waterways

TABLE 5. MAN-HOURS FOR FABRICATION AND INSTALLATION OF STRESSED-SKIN PANELS AS DETERMINED BY USE IN FARM BUILDING CONSTRUCTION

Panel description	Building description	Man-hours per panel			Man-hours per square foot of surface
		Assembly	Installation	Total	
4 x 12 ft over-all, ⅜-in. plywood on 1 x 6-in. undressed longitudinals, four per panel	28 x 60-ft umbrella shelter, 14—17 ft high at eaves. Power hoist on truck to lift panels to roof top.	1.3	1.2	2.5	0.052
4 x 8 ft over-all, ⅜-in. plywood on 1 x 6-in. undressed longitudinals, four per panel	30 x 60-ft glue-laminated arch barn. Panels manhandled into place by two men, starting at ground level.	0.8	0.5	1.3	0.041
4 x 8 ft over-all, 3/16-in. asbestos-cement on 2 x 4-in. dressed longitudinals, four per panel.	15 x 24-ft umbrella livestock shade. Front-end loader on tractor used to place panels.	1.7	0.5	2.2	0.069

wood covers 12 ft long; a one-hinged, glue-laminated arch frame barn that employed both curved and flat stressed-skin panels with plywood covers 8 ft long and a livestock shade of 8-ft-long stressed-skin panels with asbestos cement covers. The man-hour requirements for panel fabrication and building erection for each of the three structures are listed in Table 5.

Umbrella-Frame Utility Shelter. This 28 ft wide by 60 ft long shelter consisting of 4 by 12-ft stressed-skin flat panels on umbrella frames 12 ft on center has been described by Mahoney (2).

The panels were supported by a 3-in. projection or lip of the plywood cover at either end. This lip was carried on the main roof frames. It was recognized that this method of support would induce stresses tending to peel the skin from the longitudinals, but it gave the important advantage of automatic alignment of the panels and umbrella frames as the panels were dropped into place.

A two-man crew was used for assembly of the panels. For erection of the shelter a four or five-man crew, including a winch truck operator, one or two helpers on the ground, and two men on an elevated platform to position the panels on the roof appeared to be the minimum size of crew that could work effectively.

One-hinged Arch Barn. Curved stressed-skin panels 4 by 8 ft with plywood covers were used in constructing a 30 x 60-ft hay shelter. The shelter was framed with one-hinged, glue-laminated arches curved to a 15-ft radius and spaced 8 ft on centers. The panels were assembled from 4 ft by 8 ft by ⅜-in. exterior type, unsanded, grade C-C fir plywood glued to No. 1 southern yellow pine 1 by 6-in. longitudinals, undressed except for the edge to which the cover was bonded. Headers at the ends of the longitudinals were omitted. This permitted the panels to be bowed to the curvature of the ribs when installed.

It appeared necessary to provide attachment of the longitudinals to the glue-laminated arches. Three devices were tried, each of which were thought to have merit. These included *(a)* a Z clip installed at the end of each longitudinal during fabrication, *(b)* an L clip, and *(c)* a nailing block applied at the juncture of each longitudinal with the supporting arch.

The Z clip could be nailed to the arch from the top, but the other two devices had to be installed by working beneath the roof from an elevated platform. The Z clip attachments were found to be somewhat troublesome, because during adjustment of the panel into final position, the clips occasionally caught on the rib and became deformed as the panel was adjusted. All the panels were placed manually by two workmen. Panels for the upper portion of the building were slid upward into position from a platform on a farm wagon. An interior view of the completed structure is shown in Fig. 8.

Livestock Shade. Panels 4 by 8 ft assembled with 3/16-in. asbestos cement covers on frames of four, 2 by 4-in. dressed longitudinals were used for the roof of a 15-ft 4-in. by 24-ft, single-mast umbrella-type livestock shade. Casein glue and lead-headed nails were used to bond the asbestos cement skin to the frame. It was found desirable to predrill the

Fig. 8 Interior of one-hinged arch frame barn covered with preassembled stressed-skin panels

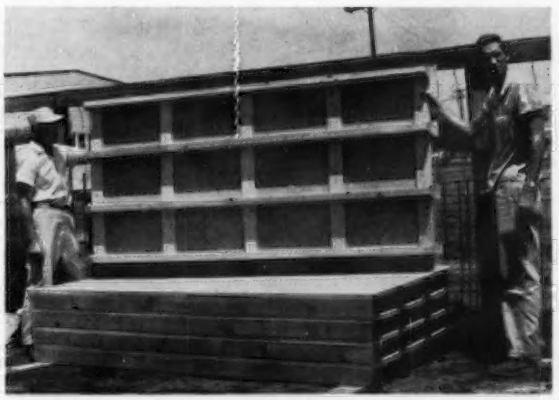

Fig. 9 Stressed-skin panels assembled from 3/16-in. asbestos-cement glue-nailed to 2-in. by 4-in. frame

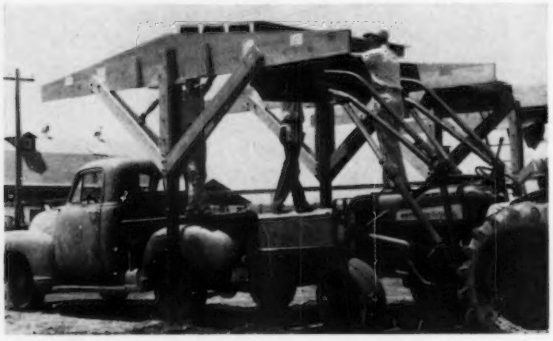

Fig. 10 Installation of asbestos-cement stressed-skin panels for roof of an umbrella-type livestock shade

sheets to prevent cracking during nailing. A tractor front end scoop was used to lift the panels into place on the shelter frame. Special care was needed in handling and lifting the panels into position to avoid breakage of the projecting ends or lips of asbestos cement. The panels are shown in Fig. 9, and the placement method in Fig. 10.

Discussion

Stiffness of Flat Panels. The data in Table 1 revealed pronounced differences in panel stiffness due to gluing compared to a well-designed nailing pattern for attaching the cover, and due to the effect of the added stiffness of 1 by 6-in. undressed longitudinals compared to 2 by 4-in. dressed longitudinals. The panels consisting of 1 by 6-in. undressed longitudinals with glued-on covers were more than three times as stiff as the panels consisting of 2 by 4-in. dressed (S4S) longitudinals with nailed-on covers. This three-fold stiffness increase was achieved with a 16 percent reduction in cross section, calculated on the basis of nominal sizes. In agricultural and light industrial structures, the first cost of which is an important consideration to the owner, such possibilities for increased stiffness with less material should be fully exploited by the structural designer.

A comparison of the stiffness factor of 82.6×10^6 lb-sq in. in Table 1 for panel design A-G, consisting of a ⅜-in. plywood cover glued to four non-symmetrically placed 2 by 4-in. dressed longitudinals, with the stiffness factor of 125×10^6 lb-sq in. in Table 3 for a comparable design but with longitudinals symmetrically placed, indicated that the position of the longitudinals and possibly the deflection during the loading test affected panel stiffness. The former panels had wider spacings between longitudinals, which possibly permitted more transverse buckling of the cover.

Panel design A-G was tested with a span of approximately 11 ft. The deflection produced by the superimposed load of 1500 lb averaged 0.76 in. The corresponding deflection-to-span ratio was 1 to 176. The panels to which Table 3 pertains had a span of approximately 8 ft. The deflection produced by a superimposed load of 1400 lb averaged 0.15 in. The corresponding deflection-to-span ratio was 1 to 625. The greater bending stresses and deflection in the longer panels plus the wider spacing between longitudinals was believed to account for the differences in stiffness factor between the 12-ft and 8-ft panels, even though both contained the same amounts and sizes of materials.

The data of Fig. 4 on transverse variation of strain in the plywood covers of 12-ft-span, stressed-skin panels revealed that some reduction in effectiveness of the cover was caused by transverse buckling between longitudinals. This was evidenced by reduced strain in the cover between the longitudinals compared to directly over the longitudinals. It appeared that the addition of transverse stiffeners could produce a stiffer panel.

The longitudinal stiffness of asbestos-cement, stressed-skin panels was apparently affected by the presence of transverse stiffeners, according to the data of Table 4. Presumably the panels with transverse stiffeners, that is, designs B and C, experienced less lateral buckling of the cover between the longitudinals.

Stiffness of Curved Panels. The panel stiffness factor as determined by loading experiments was not increased by bowing the panel, compared to a flat panel, to the extent that theory indicated. For example, the data of Table 2 and Fig. 7 indicated that the deflection of the curved panels was at least 92 percent of the same panel loaded flat, whereas theory indicated the deflection should be reduced to a minimum for the curved designs of 71 percent of the same panel loaded flat. The disparity between actual and theoretical performance was less for the wider longitudinal spacings.

Martinson (3) suggested that this discrepancy may have been due to the size of the test loads. He found from analysis of variance of the data from load-deflection experiments with flat and curved panels that the effect of differences in magnitude of superimposed load produced a higher variance in the value of Φ, the deflection ratio, than panel curvature or any of the panel-design variations. It appeared that actual performance in better agreement with theory would be obtained by using sufficiently high values of superimposed load to produce the same average deflection for all panels. Relative performance could then be evaluated by comparing loads to produce the given deflection. Furthermore, since the load-deflection characteristic of a panel at relatively light loads is not as indicative of true structural capability as this characteristic evaluated at heavier loads for which minor end effects are of less influence, the loading experiments should be performed with relatively large loads.

Application of Stressed-skin Panels. The data of Table 5 revealed that stressed-skin panels could be fabricated and installed for a total man-hour requirement of from 0.04 to 0.07 man-hours per square foot of panel area. Conditions which affected the fabrication and erection time included panel size, cover material, kind of equipment or method used to install the panels, and size and height of the structural frame to which the panels were applied. For example, installation of the 8-ft panels on the glue-laminated arch barn proceeded comparatively rapidly because installation started within reach from the ground. As application continued up the side and top of the building, the panels already installed were used as a working platform. Roof cleats temporarily nailed to the installed panels provided a foothold for the workmen. The panels were laid up the roof from a stack on the ground or on a platform on a farm trailer. Installation of the panels on the umbrella-type hay shelter was not as convenient, because it was necessary to hoist the panels, three at a time in a rope sling, from the ground to a height of 16 to 18 ft where they were deposited on the roof.

None of the workmen who assembled or installed the panels were highly skilled or experienced. Faster assembly and erection times probably would occur if skilled carpenters were used.

Self-alignment of the structural frame appeared to be an advantageous feature of the panels. This eliminated much of the work usually done to align the main frames before installation of the roof system.

It would appear that further improvement could be made in the method of supporting or attaching the panel longitudinals to the main frame elements. The metal Z clip used in one of the construction projects was not completely satisfactory, since it became bent and twisted when final adjustments were made in the panel as it was installed. Other systems that used nailing blocks or metal L brackets attached from the underside of the roof after installation of the panels had the obvious disadvantage of additional labor done under awkward and somewhat hazardous circumstances.

Panel installation was simplified by the detail of Fig. 2 *(d)*. An adequately strong bond between the cover and the longitudinals was needed to resist the peeling stresses that occurred at the panel ends. A jig appeared to be essential for fabrication of the panels. A suitable jig was a 1-in. plywood surface on a 2 x 6-in. frame. Blocks were nailed to the surface to automatically position the panel longitudinals and cover.

Summary and Conclusions

Experiments were conducted to measure the stiffness factors of selected designs of stressed-skin panels with single covers. The designs were chosen on the basis of a rational analysis of requirements for preassembled panels to use structural material efficiently and to permit rapid, convenient erection. Most of the experiments were done with panels with a ⅜-in. plywood cover. A limited amount of testing was done with asbestos-cement-covered panels. Variation of longitudinal strain with transverse position was measured on one of the plywood-covered panel designs. Field erection studies were conducted in which stressed-skin panels were used on three different buildings. Information on time for fabrication and installation of stressed-skin panels was obtained, and observations were made on the effectiveness of the erection procedures used.

The following conclusions were drawn from this work:

1 Stressed-skin panels can be used for rapid erection of farm structures. Their use is accompanied by savings in construction materials and some simplification of building erection.

2 Stressed-skin panels with a single cover can be designed to meet the strength and stiffness requirements for farm shelter roofs.

3 A typical stressed-skin panel with a glue-nailed plywood cover and 1 x 6-in. undressed longitudinals was found to be more than three times as stiff as an otherwise comparable panel, but with 2 x 4-in. S4S longitudinals to which the cover was only nailed.

4 Asbestos-cement covers can be used for stressed-skin panels. Some additional care is needed in assembly and installation of the panels to avoid cracking or rupturing the asbestos cement.

5 Variation in longitudinal strain in the plywood cover of a stressed-skin panel, with a longitudinal spacing of 14 in., was less than 20 percent across the cover. Transverse stiffeners in the asbestos-cement-covered panels were found to increase the stiffness factor by approximately 15 percent.

6 Transverse curvature or bowing of plywood stressed-skin panels was found to slightly increase panel stiffness, but not to the extent predicted by theoretical considerations, compared to flat panels. Maximum effect was obtained when longitudinals were closely spaced. When the longitudinals were widely spaced or the radius of curvature was large, the stiffness for the curved panels was less than for flat panels.

7 Total time for fabrication and installation of stressed-skin panels in farm shelters varied from 0.04 to 0.07 man-hours per square foot of panel area. Variations occurred due to differences in panel size, panel-cover materials, erection methods and equipment used, and building size and shape.

8 An important advantage of the type of panel used in the present study was found to be the automatic alignment of the structural frame that occurred when the panels were installed.

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Highway Research Estimate Reported

AN expanded national program of highway research, extending over the next four or five years, at an estimated cost of $34 million, has been recommended in a special report to the Highway Research Board, a unit of the National Academy of Sciences-National Research Council. The report, based on a two-year study by a five-man technical committee, suggested in connection with the research on soils that possibly nuclear energy may transform clays and other now undesirable materials into useful aggregates. Among high-priority investigations urged by the committee is a project in road maintenance. In the areas listed in the report of needed research of interest to agricultural engineers are:

	Estimated cost over 4 or 5 years
Controlling development of land in vicinity of freeway interchanges	$ 200,000
Improvement of knowledge of aggregate and soils	10,000,000
Conceptual study of non-user and community benefits of highway construction in relation to user benefits	1,000,000
Standards for secondary and local roads	50,000

ROTC Credit Change

THE Army has announced that starting in the academic year 1960-61, advanced ROTC students (juniors and seniors) will be permitted to take up to 20 percent of their military credits in academic courses which include science and engineering. This will reduce the burden on undergraduate students while, at the same time, giving recognition of the value of engineering and scientific courses in relation to military science.

. . . Fibreglass Filter

(Continued from page 693)

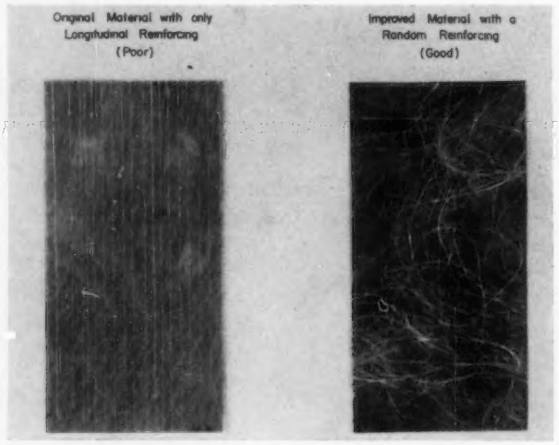

Fig. 7 The fiberglass materials tested as filter for closed tile drains

Conclusions

The original fiberglass material containing only longitudinal uniform reinforcing has insufficient lateral strength. This combined with poor filtering characteristics make it unsatisfactory for general use. The improved fiberglass containing random fibers for reinforcing performed satisfactorily. The following are the specific conclusions from the research results reported in this paper:

(a) Based on samples of the improved material tested, the amount and size of soil particles of any field sample which will pass through the fiberglass material can be estimated through use of Fig. 3 and the mechanical analysis of the sample being examined.

(b) The conservative stability criteria recommended for general use is that the 50-percent size from the mechanical analysis shall be greater than or equal to the average diameter of opening in the fiberglass sheet.

(c) Fig. 5 provides a simple method for determining whether the improved fiberglass will adequately prevent the particular field soil being examined from entering the drainage system.

(d) When installing a sheet or roll of fiberglass laid over tile, it must be completely covered by at least 2 in. of hand-placed top soil to insure against damage during machine backfilling.

Summary

Two fiberglass sheet materials, one containing longitudinal reinforcing and the other an improved material with random reinforcing, have been examined to determine their suitability for use as a filter material for tile drains.

The original material with only longitudinal reinforcing was found in general unsatisfactory, whereas the improved fiberglass performed satisfactorily. For the improved material a criteria was established (Fig. 5) for determining what soils can be prevented from entering a drain. The criteria when compared with available data shows that the improved fiberglass material will function satisfactorily in most unstable soils. Under limited tests there has been no indication of clogging or sealing of the fiberglass.

A cursory examination of fiberglass strength withstanding impact loadings during machine backfilling indicates that from 2 to 4 in. of soil must be placed over the sheet manually in order to insure against tearing and breaking the material. If these precautions are exercised, then use of the fiberglass material can result in reduced installation costs and thereby effect greater economy in the drainage of agricultural land.

Appendix

Manufacturer's Description of Fiberglass Materials Tested

Property	Original Material (Longitudinal reinforcing)	Improved Material (Random reinforcing)
Type glass	Lime borosilicate	Lime borosilicate
Type binder	Phenol-formaldehyde	Phenol-formaldehyde
Percent binder	18±2 percent	19±2 percent
Type reinforcing yarn	150—1/0	150—1/0
Reinforcing yarn spacing	¼-in. centers	Swirl
Weight per 100 square feet	1.05 lb.	1.20 lb
Nominal thickness	0.020 in.	0.020 in.
Break strength (minimum)	45 lb per 3-in width	27 lb per 3-in. width (lengthwise) 18 lb per 3-in width (crosswise)

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Engineering Enrollment Decline Analyzed

THE reasons for the continued decline in freshman engineering enrollment, as reported in the "Engineering and Scientific Manpower Newsletter" of June 1, 1960, appear to be: (1) Increased interest by qualified students in other fields of science; (2) concern over the rigors and demands of engineering education; (3) decrease in applications from students lacking in genuine interest and motivation for engineering.

These causes were revealed in a special survey conducted by the Engineering Manpower Commission of Engineers Joint Council, compiled from statements of 150 engineering deans. The trend started in 1958-59 when freshman engineering enrollments dropped 11.1 percent over the previous year. The 1959-60 drop was 3.4 percent. Public institutions in the south and mountain states were most affected.

Many deans were critical of the high school preparation received by engineering applicants. There was also a general concensus on the need for the engineering profession to establish more effective means of communicating to young people, facts about engineering, its importance and its rewards. The weight of evidence indicates that the freshman class this year will be larger than the 1959 class. Copies of the complete report may be secured from the Engineering Manpower Commission, 29 W. 39th St., New York 18, N. Y.

ASAE Annual Meeting Council Action

AS reported in the February, 1960, issue of AGRICULTURAL ENGINEERING (page 85), the ASAE Council has decided that a thumbnail sketch or resume of pertinent Council actions be printed in the Journal after each meeting in order that the general membership might have a better understanding of the discussions and deliberations carried on in their behalf by their elected representatives. In accordance with this decision, following is an account of the matters that were acted upon during the Council sessions held before and during the 53rd Annual Meeting in Columbus, Ohio, June 12-15, 1960.

President L. H. Skromme, in his opening remarks, announced that he had attended 15 section meetings, three student branch meetings, and had made four trips on behalf of the Society to attend meetings of related organizations. He reported that he had traveled an estimated 35,276 miles. He was extremely well impressed by the good work of the ASAE sections. Noting the efforts being made toward greater engineering unity among the engineering professional societies, he credited the EJC work in this direction as quite impressive. ASAE could gain much through continued close cooperation with other societies through EJC, he said. He also reported on the solicitation of industry for contributions to the motion picture fund, for which he prepared over 200 letters to a carefully screened list of industries.

The ASAE headquarter's report was given by Secretary Butt, Treasurer Palmer, Advertising and Public Relations Manager Mulbar, and Editor and Publisher Basselman, with each covering his aspect of the Society headquarters responsibilities. The meeting was then opened for business with the following transaction: The remaining balance of the Ferguson Fund, amounting to $592.12, was allocated for the purpose of preparing promotional materials for the ASAE motion picture. The Five-Step Plan for promoting the ASAE motion picture was presented by the headquarters staff.

Howard Nuernberger reported as ASAE observer to the Engineers Joint Council, covering: (a) EJC cooperation with Engineering Index, the National Science Foundation and other organizations on translations of technical articles; (b) trends in freshman engineering enrollment; (c) EJC International Relations Committee group to visit Russia; (d) EJC not recommending a National Register of Engineers; and (e) EJC endorsing ASCE resolution on relationship between public and private engineering services in government agencies.

L. W. Hurlbut reported on the progress of the Motion Picture Production Committee. The Council extended commendations to the Motion Picture Production Committee, the Motion Picture Finance Committee, the ASAE president, and to H. S. Pringle for outstanding work on the motion picture project.

A question as to advisability of the Society sponsoring special conferences, such as the one on Farmstead Engineering in September, was raised. Discussion indicated that for future conferences, the Council would take a good look before authorizing a conference, that cooperators in other technical fields would be invited to such conferences, that each conference would be considered individually on its own merits when proposed to Council, and that in all such conferences the possibility of broadening the coverage or influence areas would be considered.

It was decided not to award certificates in recognition of service to the retiring division, section, and Council officers but instead it was suggested that the ASAE president each year write a letter of appreciation to division chairmen for their professional services during the Society year.

A progress report on CIGR relationships revealed that President Skromme would be visiting Europe and had made an appointment with Mr. Blanc, secretary of CIGR. Any travel expenses incurred by President Skromme in modifying his company travel itinerary in Europe so as to confer with Mr. Blanc were authorized. President Skromme also described and reported on the proposed International Technical Congress of Agricultural Machinery and indicated that he would also confer with officials of this meeting while in Paris.

Since total membership in ASAE has exceeded 5,000 and the majority of its voting members were in the corporate grade it was moved that ASAE apply for constituent membership in EJC.

A motion to modify the Society's By-Laws in order to give division chairmen direct responsibility in appointing all division committees, rather than to have them officially appointed by the Society president, was defeated.

A movement was started to change the name of the "Council" of ASAE to the "Board of Directors," to more properly indicate the function and responsibility of this body. The term "Council" was considered not descriptive of its responsibilities. Many members, and representatives of other organizations, do not appreciate the significance of this body of ASAE. Initial action was authorized by a motion that a petition be developed, signatures obtained, and presented at the forthcoming Society business meeting. (The business meeting approved the petition and directed that the proposed constitutional amendments be presented to the full voting membership for action by letter ballot.)

A report on the TRANSACTIONS of the ASAE was given by the editor, and it was decided that during the Society year 1961 one general issue and one special issue, devoted to power and machinery subjects, be published, provided the Power and Machinery Division could give satisfactory guarantee of adequate circulation to avoid deficit financing; otherwise that two general editions would be published during 1961. Further discussion as to what direction should be followed in developing TRANSACTIONS in the future led to a proposal that pertinent facts and information concerning TRANSACTIONS be compiled and presented to all division Steering Committees prior to the Memphis winter meeting, and that each division Steering Committee be asked for a specific recommendation concerning future publications of TRANSACTIONS.

A letter request from the chairman of the Technical Committee of the Power and Machinery Division asked that the ASAE Safety Lighting Standard be given wider distribution.

Council members expressed particular interest in a letter report from George Wormley, who represented the Society at the 1960 meeting of the American Academy of Political and Social Science.

Consideration was given to a reorganization of the ASAE standards as they appear in AGRICULTURAL ENGINEERS YEARBOOK to get them into a more logical sequence. This suggestion was referred to Editor Basselman.

A suggestion that pictures of individual members be included in the ASAE directory, in addition to the information currently carried, was referred to the editor for further consideration.

Secretary Butt, as a member of the EJC Advisory Committee to the publication *Who's Who in Engineering*, invited suggestions relating to the publication.

H. F. McColly reported for the ASAE Finance Committee on the current financial status of the organization and its investments. He made special mention of the remodeling job recently completed at the ASAE headquarters office and reported that headquarters now looked the part of a "permanent headquarters office of a growing professional organization."

D. D. Smith reported for a special committee appointed to investigate the appropriateness and possibility of a monograph series of publications. The Council recommended that the committee collaborate with Editor Basselman before completing its report and submitting it for action by letter ballot.

President Skromme, speaking for the entire Council, expressed appreciation to the three members completing their terms of membership on the Council. The three, Messrs. Anderson, Ridout, and G. E. Henderson, expressed appreciation and offered further cooperation in carrying out the objectives of the Society.

W. M. Carleton, the Society's representative to the Policy Committee, Professional Agricultural Societies, explained that the committee is made up of the major agricultural societies, including ASAE, and that this group has a representative on the Scientific Manpower Commission. The policy Committee representative to the SMC has the combined interest of the Scientific Agricultural Societies as his main interest. It also maintains close contacts with the Scientific Manpower Commission. Following discussion, the Council voted continued support of the activities of the Scientific Manpower Commission.

Dr. Carleton also described the problems associated with obtaining better classification of agricultural engineering in federal occupational literature. He recommended that the Society's committee dealing with classification of engineers in military and civilian service be continued to maintain contacts through which proper classification can be effectively emphasized.

Mr. Nuernberger, chairman of the Society's Committee on Registration, presented a proposed statement of ASAE policy on engineering registration and model law. On motion, the policy was adopted.

In response to a proposal that a committee be established to consider the possibility of having one national ASAE meeting per year, beginning in the calendar year 1966, the matter was referred to the Society's Forward Planning Committee for further consideration.

Favorable action was taken on a suggestion that inclusive dates listed on the front of the Society's meeting program cover the duration of related group meetings.

As a further measure to encourage maximum use of the Society's motion picture, the Secretary was instructed to direct a letter to the Public Relations Committee of the Society requesting that its major effort for the next Society year be placed on promotion of the motion picture.

Finance

J. W. Borden

Sections

R. G. Morgan

Colleges

A. W. Farrall

Industry

F. C. Walters

L. H. Skromme

Special Individuals

E. W. Lehmann

R. H. Driftmier

ASAE members who assumed major roles in financing and producing the ASAE motion picture "Agricultural Engineering — The Profession with a Future" are shown on this page. Above each photo is the committee or subcommittee of which he was chairman or under which he performed with distinction

. . . Over the Top

(Continued from page 662)

A. W. Farrall, head of agricultural engineering, Michigan State University, was selected as chairman of contributions from colleges and universities having agricultural engineering departments.

R. G. Morgan, district manager of industrial division, Timken Roller Bearing Co., was selected as chairman of contributions from sections. It was the feeling of the Committee that the sections would welcome the opportunity to undertake a major project in support of an activity showing as much promise in publicizing their own profession. This was set up as the only category in which the ASAE membership generally would be contacted for personal contributions.

F. C. Walters, project engineer, John Deere Research and Engineering Center, was selected as chairman for contributions from industry.

J. W. Borden was selected as chairman of the category identified as "special individual contributions" established for certain members or friends of ASAE who, in the opinion of the committee, might want to make a special contribution toward the motion picture on agricultural engineering.

Soon each subcommittee chairman mapped his plan of action and set the machinery to work. A. W. Farrall, with the assistance of A. J. Schwantes, head of agricultural engineering, University of Minnesota, contacted colleges and universities having interests in the profession. As a direct result 29 copies of the film were purchased, surpassing the quota assigned to this group.

R. G. Morgan, with assistance from W. J. Ridout, editorial director, *Electricity on the Farm*, and J. L. Butt, executive secretary of ASAE, suggested to each ASAE section a proportionate share of the quota assigned to the category on sections. As a result, practically all sections accepted their quotas and 10 actually surpassed their voluntarily accepted quotas. The results from this group could not have been realized without the tireless efforts of the section officers and the section members themselves, who many times conceived ingenious fund raising methods.

F. C. Walters, with assistance from L. E. Bradley, field manager, American Zinc Institute, and J. T. Phillips, Jr., executive vice-president, Lilliston Implement Co., was responsible for contributions from industry. At the committee's request, L. H. Skromme, chief engineer, New Holland Machine Co., as president of ASAE, sent over 200 personalized letters to a carefully screened list of industries. The response was even greater than had been estimated indicating that industry is also concerned with the expanding demand for agricultural engineering graduates — and this group also surpassed its quota by a wide margin.

To assist him in contacting ASAE members in the "special individual contributions" class, J. W. Borden called upon two past-presidents of ASAE. E. W. Lehmann, professor emeritus of agricultural engineering, University of Illinois, and R. H. Driftmier, chairman of agricultural engineering, University of Georgia, wrote special letters to those individuals they thought would like to give special contributions over and above what would be considered an average share.

Meantime, production details were being carried out. H. S. Pringle, extension agricultural engineer, Extension Service, USDA, and member of the Motion Picture Production Committee, did an outstanding job in

Production

L. W. Hurlbut

H. S. Pringle

maintaining a liaison between the Production Committee, which could meet only a few times each year, and the USDA Motion Picture Service. He also served as chief advisor of the technical content of the film with assistance, of course, from committee members and other ASAE members in the Washington, D. C., area. He served also as a contact man to assist the ASAE headquarters in transactions with the Motion Picture Service concerning delivery of prints, clarifying questions of policy, and arranging for production payments. The help H. S. Pringle was able to provide also was both time and cost saving, since he was instrumental in obtaining available film from other sources for use in the new movie.

Contributions are still being received and some accepted quotas still must be met — but we can report that the drive for funds has gone over the top! As of September 30 the total cash received at ASAE headquarters is $23,075.36. This is $75.36 over the $23,000 original goal — with additional commitments yet to be met.

At this point, it should be explained that all funds collected, in excess of the amount needed to produce the picture and to make 129 prints for distribution throughout the United States and Canada, have been earmarked for use in providing free leaflets, flyers, and posters for use in the Five-Step-Plan. This plan (see page 464, July issue of AGRICULTURAL ENGINEERING) serves as the necessary follow-up promotion effort required to achieve maximum results from the picture itself — and many contend that it is *more important* than the picture itself. But the two complement one another and both are essential to a successful activity.

We are anxious to see the *next* phase through to an equally successful completion. This job is in the hands of the ASAE sections and individual members. What is it?

(1) Seeing that each print of the picture is kept in active use.

(2) Seeing that local Career Guidance Committees follow-up on all contacts established by the picture.

(3) Seeing that the Five-Step-Plan (or some modification of it) is followed in each state.

We are confident that agricultural engineers will put this phase of the promotional activity across as effectively as they did phase one — it is characteristic of our dynamic profession.

Georgia Section Plans Silver Anniversary Meeting

The Georgia Section of ASAE, the oldest state section, will celebrate 25 years of service in agricultural engineering with its fall meeting on November 10 and 11 at the Georgia Center for Continuing Education in Athens. National President L. W. Hurlbut will share in the festivities.

Following are brief reviews of papers presented at ASAE meetings or other agricultural engineering papers of which complete copies are available. ASAE members may obtain copies of these papers without charge by returning order forms supplied upon payment of membership dues. Nonmembers, and members requesting more than 10 copies, may purchase papers at 50 cents each to cover carrying charges from the American Society of Agricultural Engineers, St. Joseph, Mich.

Report of the Committee on Drainage Equipment. This report contains the results of a survey made by the Committee on Drainage Equipment, Drainage Group, Soil and Water Division of ASAE, to assist manufacturers of such equipment to better determine the functional requirements needed in the field of drainage. It should also interest those in the field of drainage research as to some of the problems encountered by contractors. These problems may greatly influence the final quality and cost of present day installation methods. Paper No. **60-50.**

The complete report contains detailed tabulated results of a questionnaire completed by contractors. They are tabulated according to area, make and size of machine, and also according to many individual comments by drainage contractors. The committee has also listed some general recommendations for the improvement of drainage machinery.

Designing a Mechanical Sampler for Bulk Fruit Bins, by Michael O'Brien, associate specialist, agricultural engineering department, University of California, Davis. Paper presented at the Pacific Coast Section meeting of ASAE at Lake Arrowhead, Calif., April 1960. Paper No. **PC60-22.**

Inspecting samples of fruit on delivery by growers is standard practice for establishing quality grades in the fruit industry. Sampling fruit in bulk bins containing about 1,000 pounds of fruit poses a problem. This paper tells first of the survey made of machine specifications; then goes into the component testing; pilot construction and tests; and the fruit tests and performance, for the designing of a mechanical bulk fruit bin sampler.

Movements Under the Contact Area in Radial and Conventional Tires, by Arrigo Cegnar and Fulcieri Fausti, respectively, tire development department, and tractor tire development department, Pirelli, Milan, Italy. Paper presented at the Annual Meeting of ASAE at Ohio State University, Columbus, June 1960, on a program arranged by the Power and Machinery Division. Paper No. **60-104.**

The authors state that this paper takes into consideration the tread movements under the contact area of radial or tractor tires. The comparison was carried out between a radial tire and a conventional one, with the same tread pattern, by measuring their movements on a smooth surface. The tests and the results are explained in the text and in the illustrations.

Health Hazards from Farm Chemicals, by Clyde M. Berry, associate director, Institute of Agricultural Medicine, College of Medicine, State University of Iowa, Iowa City, Iowa. Paper presented at the Annual Meeting of ASAE at Ohio State University, Columbus, June 1960, on a program arranged by the Power and Machinery Division. Paper No. **60-108.**

This paper tells of the increasing farm usage of agricultural chemicals, that the variety and amounts used in the future will probably be much greater than at present, and that almost all are intended to affect protoplasm, plant or animal. The author tells how the medical profession is concerned over possible untoward effects of these materials on the man who applies them. He also explains that reducing health and safety potentials through good engineering design is desirable and feasible, and that agricultural engineers are in the best position to effect basic control over exposure and minimize the need for personal protective equipment.

Application of the Relationship Between Actual and Potential Evapo-Transpiration in Arid- Zone Agriculture, by R. M. Holmes and G. W. Robertson, respectively, soil physicist and meteorologist, agrometeorological section, research branch, Plant Research Institute, Department of Agriculture, Ottawa, Canada. Paper presented at the Annual Meeting of ASAE at Ohio State University, Columbus, June 1960, on a program arranged by the Soil and Water Division. Paper No. **60-200.**

Soil moisture control is one of the most acute problems of arid and semi-arid agriculture. This paper explains some of the relationships between crops and soils and the amount of water that is given up to the atmosphere — evapotranspiration. Also discussed are tests and experiments in the relationship of actual evapotranspiration and potential evapotranspiration. The results of these tests are outlined in two moisture budget or bookkeeping schemes.

Utilizing Drop Inlet Structures for Erosion Control on Navy Land, by Howard D. McMurtry, agricultural engineer (conservation), District Public Works Office, Fifth Naval District, Norfolk, Va. Paper presented at the Annual Meeting of ASAE at Ohio State University, Columbus, June 1960, on a program arranged by the Soil and Water Division. Paper No. **60-209.**

Where there are large-scale construction projects that involve major grading operations, there is always the possibility of creating erosion problems which, if not corrected, will result in very costly maintenance. The material presented in this paper is devoted to the use of drop inlet structures on Navy land to control erosion in large gullies where runoff from small watersheds can cause serious damage. Also discussed briefly are the approximate flood routing equations, developed by engineers of the Soil Conservation Service, and the weir and pipe flow formulas, which were the only ones used in the design of the structures described in this paper.

Grain Drying with Supplemental Heat, by W. V. Hukill, principal agricultural engineer, harvesting and farm processing research branch, AERD, ARS, USDA, Iowa State University, Ames. Paper presented at the Annual Meeting of ASAE at Ohio State University, Columbus, June 1960, on a program arranged by the Electric Power and Processing Division. Paper No. **60-303.**

This paper discusses supplemental heating in in-storage drying with the air heated to not more than 20 F above atmospheric temperature. When combined with layer drying it provides a way to use storage buildings more economically than with unheated air. A detailed discussion of the design procedure shows the important economic limitations that are encountered in in-storage drying and how supplemental heat relaxes the limitations.

Design of Bin-Drying Systems to Fit Expected Harvesting Rate, by William H. Peterson, extension rural electric specialist, South Dakota State College, Brookings, S. D. Paper presented at the Annual Meeting of ASAE at Ohio State University, Columbus, June 1960, on a program arranged by the Electric Power and Processing Division. Paper No. **60-304.**

The author states that the turning point toward widespread acceptance by the farmer of drying-in-storage will probably be marked by the availability of "package" bin-fan-heater systems. In this paper, he attempts to show a method that can be used to give a farmer an indication of the drying rate and harvesting rate he can expect from a given set of circumstances. This paper also makes possible comparison of different bin-fan-heater combinations in terms of probable harvesting-loading rates.

Factory Fabricated Plywood Components for Farm Structures, by M. T. Fast, agricultural field representative, Douglas Fir Plywood Association, Tacoma, Wash. Paper presented at the Annual Meeting of ASAE at Ohio State University, Columbus, June 1960, on a program arranged by the Farm Structures Division. Paper No. **60-414.**

The author states that the future of the building industry lies in the use of factory fabricated components manufactured on a production line under controlled conditions and which can be quickly assembled into buildings at the job site. In this paper he discusses the basic components that offer agricultural engineers more design freedom —trusses, stressed skin panels, box beams and curved panels. These units can be combined into roof systems, floor systems, load-bearing walls, and sandwich panels can also be manufactured for curtain walls. Also explained are the functions of Plywood Fabricator Service, a non-profit service organization and an affiliate of Douglas Fir Plywood Association.

A Phytotron with Controlled Solar Lighting, by L. W. Neubauer and I. J. Szluka, respectively, associate professor of agricultural engineering and assistant specialist in agricultural engineering, University of California, Davis. Paper presented at the Annual Meeting of ASAE at Ohio State University, Columbus, June 1960, on a program arranged by the Farm Structures Division. Paper No. **60-425.**

According to this paper, a phytotron may be considered a shelter or facility to be used for the study of any type of plant growth under controlled environmental conditions, and it describes the phytotron at the University of California, giving its structural features and costs. Also discussed are the phytocube, a temporary smaller model, and the heliostat. A summary includes the results of roof-lighting tests and experiments on the plant growth chamber at the University.

Farmstead Engineering Conference Appeals to Diverse Audience

(Left) Herbert N. Stapleton, agricultural engineer, Shelburne Farms, discussed "Future Farmstead Power Requirements"

(Above) Virgil Herriott, general manager, Sioux Valley Empire Electric Association, Inc. posed the question "From Where Will the Power Come?"

Representation from manufacturers of farm buildings and farmstead mechanization components; colleges and universities; major publications; large associations interested in farmstead development; the U.S. Department of Agriculture; electric utilities; as well as agricultural engineering consultants and farm and large cooperative association managers were in attendance at the Farmstead Engineering Conference on confinement housing of livestock, held September 13-15 at the University of Illinois Lincoln Hall Theater, Urbana.

College representation was extremely broad, including representatives from 29 states extending from coast to coast and from all regions of the United States, as well as representation from Puerto Rico, several Canadian Provinces and Germany.

The most current information on all factors affecting confinement housing of four groups of livestock (poultry, swine, dairy and beef) from the standpoint of management, breeding, feeding, sanitation, marketing and other future considerations which may affect farmstead engineering was advanced during the 3-day conference. Basic and functional requirements of animals were presented in a way that is useful to designers. Design procedures and solutions for combinations of components for economical operation were outlined also for each type of livestock covered. In order to present a complete picture of all factors involved in farmstead engineering, the areas where basic research is needed, cost vs. returns of engineering housing systems, and power requirements of engineered farmsteads were presented by those regarded as specialists in their respective fields.

Many ideas highlighted the conference. Roy Van Arsdall, USDA agricultural economist, University of Illinois, emphasized the fact that because buildings and equipment are a small part of the annual costs of livestock enterprises an increase of 50 percent in the cost of a building increases the cost of production only 5 percent. "Cost of production records are becoming a 'must' for farmers who need to borrow operating capital. However, money is available in amounts large enough to meet present day needs of engineered farmsteads," said Douglas Graves, assistant vice-president, Chicago National Bank. D. G. Jedele, associate professor of agricultural engineering, University of Illinois, pointed out that investment per hog for farrowing-to-finish swine houses is as low as other well-managed 2 and 3-building systems, and that many factors favor the one-house system and may make it the first choice for many. Thamen Hazen, professor of agricultural engineering, Iowa State University, reported that hogs weighing 50-200 pounds are affected by extremes in temperature much more than pigs from 12 to 50 pounds, and that better housing and equipment to control temperature can be better justified for growing and finishing hogs than for the smaller pigs. The entire proceedings of the Farmstead Engineering Conference were published in the September issue of AGRICULTURAL ENGINEERING, and copies are available from ASAE, St. Joseph, Michigan, at $1.25 each (ten or more copies, $1.00 each).

During and following the meeting, participants enjoyed tours of the Illinois Agricultural Experiment Station research work in automatic feed handling for hogs, beef, and dairy cattle. They also inspected the research work in farm structures, including the Morman Breeding Research Institute, which is being erected. The Farmstead Engineering Conference committee, consisting of E. L. Hansen, chairman, E. D. Anderson, K. H. Beauchamp, S. S. DeForest, M. W. Forth, C. W. Hall, C. F. Kelly, and H. A. Mulbar, has made a major contribution to the future growth and development of confinement housing and farmstead mechanization by bringing into focus the many interrelated facets of this new field for agricultural engineers.

(Right) Informal gatherings between sessions provided an opportunity to exchange latest farmstead engineering developments. Left to right are: F. P. Stephan, project engineer, James Mfg. Co.; H. J. Barre, consulting engineer; F. W. Kesler, farm products research and development department, Rilco Laminated Products, Inc.; W. E. Turner, research engineer, Butler Manufacturing Co.; and R. B. Furry, extension agricultural engineer, Cornell University

(Right) The success of any conference depends upon the hard work of its arrangements committee and those who took part. Some of these workers were available for the photographer: *(Left to right)* H. H. Beaty, professor of agricultural engineering, University of Illinois, presided over the Wednesday evening session; C. W. Hall; S. S. DeForest; E. L. Hansen, E. D. Anderson; and F. B. Lanham, head of the agricultural engineering department, University of Illinois, gave the welcoming address. Hall, DeForest, Hansen, and Anderson were all members of the committee for the Farmstead Engineering Conference of which Hansen was chairman

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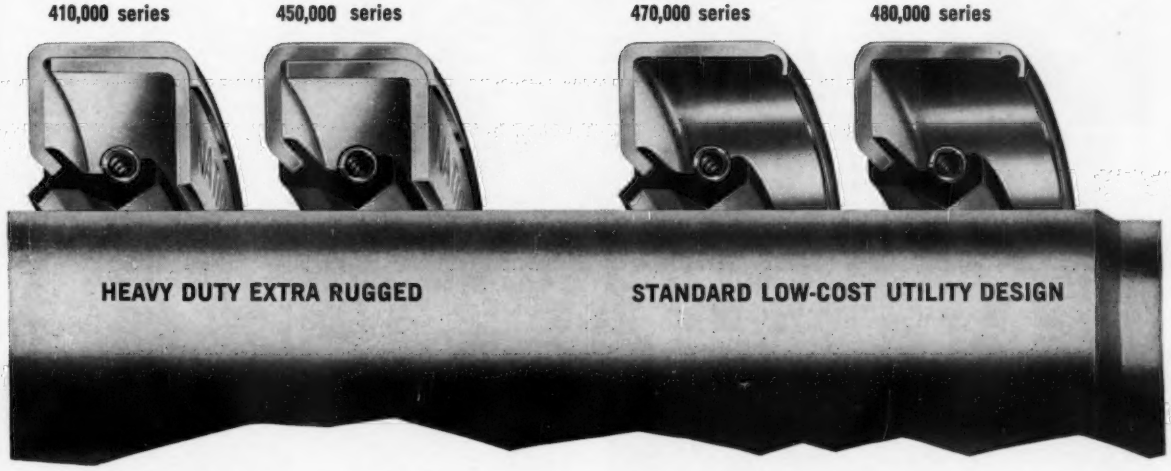

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Mason Vaugh Elected Honorary Member

In recognition of his approximately 39 years of distinguished service to the agricultural engineering profession, the Council of ASAE has recently elected Mason Vaugh to the highest grade of membership in the Society, that of Honorary Member. He has been an ASAE member since 1923 and a Life Member since 1956.

Mason Vaugh

Mr. Vaugh was born in Bonne Terre, Mo., and graduated from the Flat River, Mo., high school. His advanced education was obtained from the University of Missouri, where in 1919 he received a B.S. degree in agriculture and in 1921 was the second person to receive a degree in agricultural engineering from the University. In 1928, he received the professional degree of agricultural engineer, then offered by the University.

After graduation in 1921, he went to India as a Presbyterian missionary in the Allahabad Agricultural Institute. From that time until 1953, he was head of the department of agricultural engineering and was the first person in India to teach a course under the title of "agricultural engineering." Due to his initiative and endeavors, in 1942 a degree course leading to a B.S. in agricultural engineering was started at Allahabad Agricultural Institute, one of the affiliated colleges of Allahabad University. This was the first institution in India and the whole of southeast Asia to start a course in agricultural engineering. In 1957, he retired from his position as professor of agricultural engineering at the Institute, and in 1958 accepted an assignment as executive secretary of the Laymen's Committee on Economic Life and Worldwide Christian Community. He retired, in 1959, as a missionary of the Presbyterian Church, but continued as technical advisor of the implement factory, which he developed.

A prolific writer and teacher, Mr. Vaugh has authored and co-authored scores of technical papers and articles and has trained over 1500 persons—approximately 200 of which have received agricultural engineering degrees. Called by his associates "the Father of Agricultural Engineering in India," he has served as a member down through the years on the Advisory Board of Agriculture to the State and Central Governments of India, on the Advisory Committee of the Agricultural Engineering Department of the Indian Institute of Technology, on the Indian Council of Research and the Uttar Pradesh State Board of Agriculture, as well as two of the country's top scientific societies. Among his other accomplishments are the development of several new implements and small machines especially suited to Indian farming conditions; organization of the Agricultural Development Society to manage a factory and produce farm implements; starting and managing a testing station for testing agricultural implements and machines manufactured in India. The University of Missouri honored him in 1958 by bestowing on him the Missouri Honor Award for Distinguished Service in Engineering and Engineering Foundation.

New ASEE Officers

As a result of a national mail balloting by the 9,300 members of The American Society for Engineering Education, the following new officers were elected: Eric A. Walker (president, Pennsylvania State University), president; Melvin R. Lohmann (dean, Oklahoma State University), vice-president; Newman A. Hall (professor, Yale University), vice-president; and Wendel W. Burton (Minnesota Mining and Mfg. Co.), renamed treasurer.

CITMA Congress

An International Technical Congress for Agricultural Machinery will be held March 2-7, 1961, in Paris, immediately before the "Annual Week of Agriculture." The general theme of this technical congress is the participation of agricultural machinery in the advancement of human condition and

(Continued on page 716)

1960 WINTER MEETING TO BE HELD IN MEMPHIS, TENNESSEE

The Peabody Hotel will provide the meeting space for the General Session, FEI dinner, and the Research and Extension programs. The technical sessions for farm structures, soil and water, and electric power and processing will be held there also

The technical sessions for power and machinery will be held in the newly renovated Chisca Plaza Hotel. The Chisca Plaza will also be used for the Personnel Service Session and the Educational Atomic Energy Exhibit

The American Society of Agricultural Engineers, in a departure from the usual practice of meeting in Chicago, will hold its 1960 Winter Meeting in Memphis, Tenn., at the Peabody and Chisca Plaza Hotels, on December 5 to 7. The move to Memphis was made in an effort to strengthen the professional activities of local ASAE sections and of agricultural engineering in the Mid-South area.

Both the Peabody and Chisca Plaza Hotels have very fine meeting facilities, but due to the fact that neither hotel can carry all of the meetings, the Meetings Committee decided that the Power and Machinery Division sessions would be held in the newly renovated Chisca Plaza Hotel, while all other division sessions would be held in the Peabody Hotel. Registration will begin Sunday, December 4, at 1:00 p.m. For the convenience of members, there will be a registration center and a local committee headquarters in each hotel, with direct line telephone communication between the two. Registration in the Peabody will be at the north end of the mezzanine, and at the Chisca Plaza in the main lobby. Paper distribution centers will also be located in both hotels. The exact location will be carried in the printed program, which will be mailed soon.

If the members use the reservation card provided by the Local Arrangements Committee, every effort will be made to assign them to the hotel in which their division is holding its technical sessions. The General Session, FEI dinner, the Farm Structures Milker, Research Committee Seminar, and the special Extension Program will all be held in the Peabody. The Personnel Service Contact Session and the Educational Atomic Energy Exhibit will be located in the Chisca Plaza Hotel. There will be continuous shuttle bus service between the hotels, and for those members preferring fresh air and exercise it is about a ten-minute walk between the two. Maps will be provided by the Local Arrangements Committee to facilitate those who prefer to find their own way around the city.

The Educational Atomic Energy Exhibit was developed by the Oak Ridge Laboratory at Oak Ridge, Tenn., and has been widely publicized and demonstrated throughout the United States. It is reported to be an extremely interesting, educational presentation all members should be sure to see.

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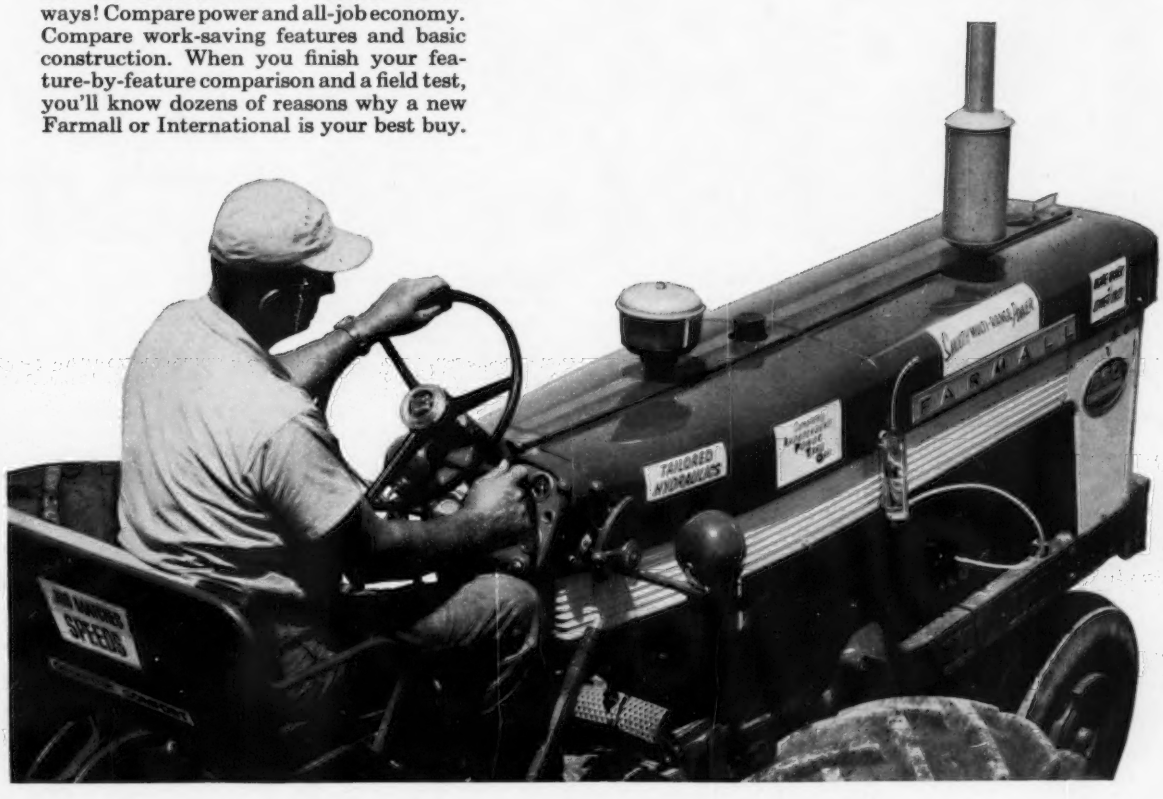

W. M. Cade

H. D. Sullivan

L. W. Christenson

J. H. Dasenbrock

A. Earl Lee

W. F. Strehlow

R. S. Reaves

T. W. Casselman

William M. Cade has been appointed divisional chief engineer, test and development section, Farm Equipment Division, International Harvester Co., Hinsdale, Ill. He started with the advanced design department of the company in 1951; was transferred in 1953 to the McCormick Works; and in 1955 was appointed chief engineer of advanced engineering. In 1956, he joined the Memphis Works as chief engineer of product and advanced engineering and served in that capacity until his recent promotion.

Herbert D. Sullivan has been promoted to chief product engineer in charge of the development of new farm machines and implements at the Memphis Works of International Harvester Co., Memphis, Tenn. He joined the company in 1951 as a layout draftsman at the Memphis plant. He later was promoted to product designer, and subsequently to assistant product engineer and to a product engineer.

L. W. Christenson, vice-president in charge of sales for Cleveland Graphite Bronze Division of Clevite Corp., recently retired from active business. He was born and raised in Reno, Nev. In 1915 he came east to Findlay, Ohio, where he worked for the old Grant Motor Car Co. During World War I, as a marine sergeant, he was a machine gun instructor. After the war, he worked for five years in the parts and service department of the Birkett L. Williams Co., a pioneer Cleveland auto agency. He joined Cleveland Graphite Co. in 1924, when the company was only five years old, and developed its sales in the Chicago area into an important portion of its business.

In the 1930's, he was the first to get acceptance for the company's new Thinwall engine bearing by a major passenger car manufacturer. He became sales manager in 1943 and was elected vice-president in charge of sales in 1948. He has been an ASAE member since 1949, and also is a member of the Society of Automotive Engineers. He now plans to do sales and marketing consulting.

J. Henry Dasenbrock, formerly product education manager, New Idea Farm Equipment Co., Coldwater, Ohio, has been promoted to the newly created post of merchandising manager. In his new capacity, he will be responsible for sales merchandising activities, preparation and planning of sales meetings and branch conferences, and over-all supervision of the product education department. He will also take over direction and supervision of export sales operations. He joined the company as product education manager in 1955.

A. Earl Lee has been appointed marketing co-ordinator for J. I. Case Co., Racine, Wis. In this position he will co-ordinate all phases of the company's marketing operation, including product development and market research. For the past three years, he has been with Massey-Ferguson, Toronto, where he served as a member of the corporate (international) marketing staff and as general manager, marketing and economic research, North American operations.

Walter F. Strehlow has been named senior consulting engineer for the Allis-Chalmers Tractor Group. Joining the company 46 years ago, he has been chief engineer at the West Allis Tractor Works since 1939. Last year he was awarded a "certificate of recognition" from the Milwaukee Patent Law Association for "his ingenuity and outstanding contribution to society through the medium of the United States Patent System."

Robert S. Reaves has been appointed chief engineer of the Farm Equipment Division Tractor Works, Allis-Chalmers Mfg. Co., West Allis, Wis. He joined the company in 1935 as a student engineer, following his graduation as a mechanical engineer from Auburn University, Auburn, Ala. He was assigned to the engineering department of the company's Crawler Tractor Works at Springfield, Ill., and in 1938 was transferred to the engineering department at the LaCrosse (Wis.) Farm Equipment Works. He was assistant to the director of engineering for the Tractor Group prior to his promotion.

T. W. Casselman advises that he is now with the Everglades Experiment Station at Belle Glade, Fla., as an assistant agricultural engineer. In his new work he will continue studies on mechanical moisture removal of water from forages, a study began by the late J. W. Randolph. Also, he expects that some work will be done on mechanical harvesting of sugar cane for forage purposes. He formerly was an associate in research at Iowa State University.

Robert R. Todd, agricultural engineer, Soil Conservation Service, USDA, recently received the Junior Engineer Award from the Indiana Society of Professional Engineers.

Roy L. Roberts, hydraulic engineer, Western Soil and Water Management Research Branch, SWCRD, ARS, USDA, has been transferred from East Lansing, Mich., to Coshocton, Ohio. He transferred from the Soil Conservation Service to the Soil and Water Conservation Research Division, College Park, Md., in 1955, where he served until his reassignment to East Lansing in 1958. In his new assignment he will do research on runoff investigations at the Coshocton Soil and Water Conservation Research Station.

Richard D. Abele, formerly assistant purchasing agent for Detroit Harvester Co., advises he is now with The Jones Metal Products Co., West Lafayette, Ohio, as an engineer in the hydroform contract division.

Lyckle Boersma has joined the Oregon State College staff as an assistant soil scientist in the soils department, at Corvallis, Ore. He previously was on the agricultural engineering staff at the University of Illinois, Urbana.

Donald J. Brosz advises that he has recently joined the Kansas State University staff, at Manhattan, as an irrigation specialist and extension engineer. He came to KSU from South Dakota State College, Brookings, where he was assistant extension agricultural engineer.

Joe M. Bunn has completed requirements for a Ph.D. degree in agricultural engineering at Iowa State University, Ames, and has accepted a position of assistant professor in the agricultural engineering department at the University of Kentucky, Lexington.

Frank R. Brower, Jr., who has been state conservation engineer with the USDA Soil Conservation Service in Pennsylvania, has transferred to SCS in Athens, Ga., where he is river basin survey party leader.

Earle F. Cox advises that he is now located in Columbus, Ohio, as chief research engineer, with American-Marietta Co. He previously was located in Pittsburgh, Pa., with the Blaw-Knox Co., where he was manager of advanced engineering and development.

Richard F. Dudley, formerly associate agricultural engineer with the Agricultural Engineering Laboratory, USDA, Beltsville, Md., has transferred to the USDA Southwestern Great Plains Field Station at Bushland, Texas.

Donn B. Furlong has accepted the position of chief engineer with Wayne Manufacturing Co., Pomona, Calif. He formerly was chief progress engineer at Bolens Products Division of Food Machinery and Chemical Corp., Port Washington, Wis.

R. W. Hough and **F. M. Farleigh** are two of a newly formed three-man divisional product supervisory staff in the Farm Equipment Division of International Harvester Co., who will assist **M. O. Curvey** (also an ASAE member), farm equipment product manager, in the co-ordination of engi-

(Continued on page 717)

On the new J. I. Case 1000 (above) and, optionally, on the new 800 Self-Propelled Combines, cylinder and concave adjustments can be made on-the-go from the driver's seat. Both of these modern machines are Fafnir equipped.

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FAFNIR
BALL BEARINGS

Mississippi Section

Organization of a state ASAE section in Mississippi was completed at a meeting on August 12 at Mississippi State University, with R. K. Smith serving as temporary chairman. The following officers were elected: Russell Woodburn, chairman; J. W. Barrows, vice-chairman (Power and Machinery); R. K. Smith, vice-chairman (Electric Power and Processing); J. G. Griffin, vice-chairman (Farm Structures); C. W. Doty, vice-chairman (Soil and Water); and T. N. Jones, secretary-treasurer. In welcoming the engineers, Dr. Clay Lyle, dean and director, division of agriculture, Mississippi State University, stressed the need for professional knowledge in meeting the nation's future need for more food, produced on less land by fewer farmers. Those in attendance were also urged by M. S. Shaw, associate director of the Agricultural Extension Service, Mississippi State University, to help explain the facts about agriculture to the public.

Formation of the new section brings to 30 the number of ASAE sections. Significant, also, is the fact that addition of the Mississippi Section makes the Southeast Section the first regional section to have a section in each of its states.

Connecticut Valley Section

The Connecticut Valley Section will hold a meeting on October 18 at the Student Union Building, University of Massachusetts, Amherst. This will be a 6:30 p.m. dinner meeting at which time officers for the coming year will be elected. The featured speaker will be Rama K. Srivastava, who is presently engaged in graduate work at the University of Massachusetts conducting research in the evaluation of the human energy requirements of hand harvesting tools. His subject will be "A Glimpse of India's Agriculture."

Iowa Section

The Iowa Section will hold a meeting on October 21 at McNeal Hi-Way Hotel, Highway 6 and Urbandale Ave. in northwest Des Moines. A registration and social hour at 6:00 p.m. will precede the 7:00 p.m. dinner. Marvin Kruse, who is chairman of the Iowa State Board of Engineering Examiners and supervisor of registration in the agricultural engineering branch, will speak on engineering registration. Wayne E. McGlade of LeTourneau-Westinghouse Co., in his presentation entitled "How Shall We Turn the Wheels?", will trace the history of the wheel and the power applied to it from early designs to present and future requirements.

Oklahoma Section

The Oklahoma Section will hold its fall meeting on Friday, October 28, on the Oklahoma State University campus in Stillwater. The papers to be presented on the program will include fields of interest from "Agricultural Engineering in Brazil" to "Engineering Use of Soil Reports." An interesting talk is also scheduled for the noon luncheon. The program will also include the showing of the new ASAE film "Agricultural Engineering—the Profession with a Future." Football fans are invited to attend the section meeting and stay over for the Oklahoma-Iowa State football game on Saturday.

Michigan-Ohio Sections

The Michigan Section will meet on Saturday, October 29, at Michigan State University, which is also the Annual MSU Homecoming date. The Ohio Section has been invited to meet with the Michigan Section in a joint technical program in the morning. Speakers from several large implement concerns will be on the program, and there will also be a ladies' program. A luncheon will be served at noon. In the afternoon the Michigan State-Ohio State football game will be played.

Virginia Section

The Virginia Section will hold its annual meeting on November 4 and 5 at Virginia Polytechnic Institute, Blacksburg, Va. One of the highlights of the program will be an address by National ASAE President Lloyd W. Hurlbut.

ASAE MEETINGS CALENDAR

October 18 — CONNECTICUT VALLEY SECTION, Student Union Bldg., University of Massachusetts, Amherst, Mass.
October 19-22 — PACIFIC NORTHWEST SECTION, Empress Hotel, Victoria, B.C., Canada.
October 21 — IOWA SECTION, McNeal Hi-Way Hotel, Highway 6 and Urbandale Ave. in N.W. Des Moines, Iowa.
October 28 — OKLAHOMA SECTION, Oklahoma State University, Stillwater, Okla.
October 29—MICHIGAN SECTION, Michigan State University, East Lansing, Mich.
November 4—WASHINGTON, D. C. SECTION, Student Union, University of Maryland, College Park, Md.
November 4-5 — PENNSYLVANIA SECTION, Pennsylvania State University, University Park, Pa.
November 4-5—VIRGINIA SECTION, Virginia Polytechnic Institute, Blacksburg, Va.
December 5-7—WINTER MEETING, Peabody Hotel, Memphis, Tenn.
April 7-8 — MID-CENTRAL SECTION, St. Joseph, Mo.
April 14-15 — SOUTHWEST SECTION, Grim Hotel, Texarkana, Texas.
June 25-28—ANNUAL MEETING, Iowa State University, Ames, Ia.
August 20-23—NORTH ATLANTIC SECTION, University of New Brunswick, Fredericton, N. B., Canada.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

Washington D. C. Section

The Washington D. C. Section held a luncheon meeting on September 9 in Room 6962, USDA South Building, Washington, D. C., with 30 members in attendance. The officers for the year, J. G. Sutton, chairman; R. L. Green, vice-chairman; and J. W. Rockey, secretary-treasurer, were introduced.

The October luncheon meeting was held on the 14th in the USDA South Building. The featured speaker was H. S. Pringle, who spoke on the Society's "Five-Step Plan" for interesting youth in agricultural engineering as a career. The program also included a showing of the new ASAE film "Agricultural Engineering — the Profession with a Future."

(Continued on page 712)

ORGANIZE NEW MISSISSIPPI SECTION

(Above) **Principals in forming of the Mississippi Section — *(Left to right)* T. N. Jones, R. K. Smith, and R. F. Colwick**

***(Right)* Officers of the newly-organized Mississippi Section are *(standing left to right)* R. K. Smith, vice-chairman (Electric Power and Processing); J. G. Griffin, vice-chairman (Farm Structures); and J. W. Barrows, vice-chairman (Power and Machinery); *(seated left to right)* Russell Woodburn, chairman; T. N. Jones, secretary-treasurer; and C. W. Doty, vice-chairman (Soil and Water)**

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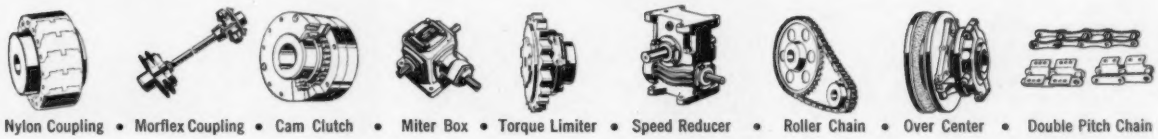

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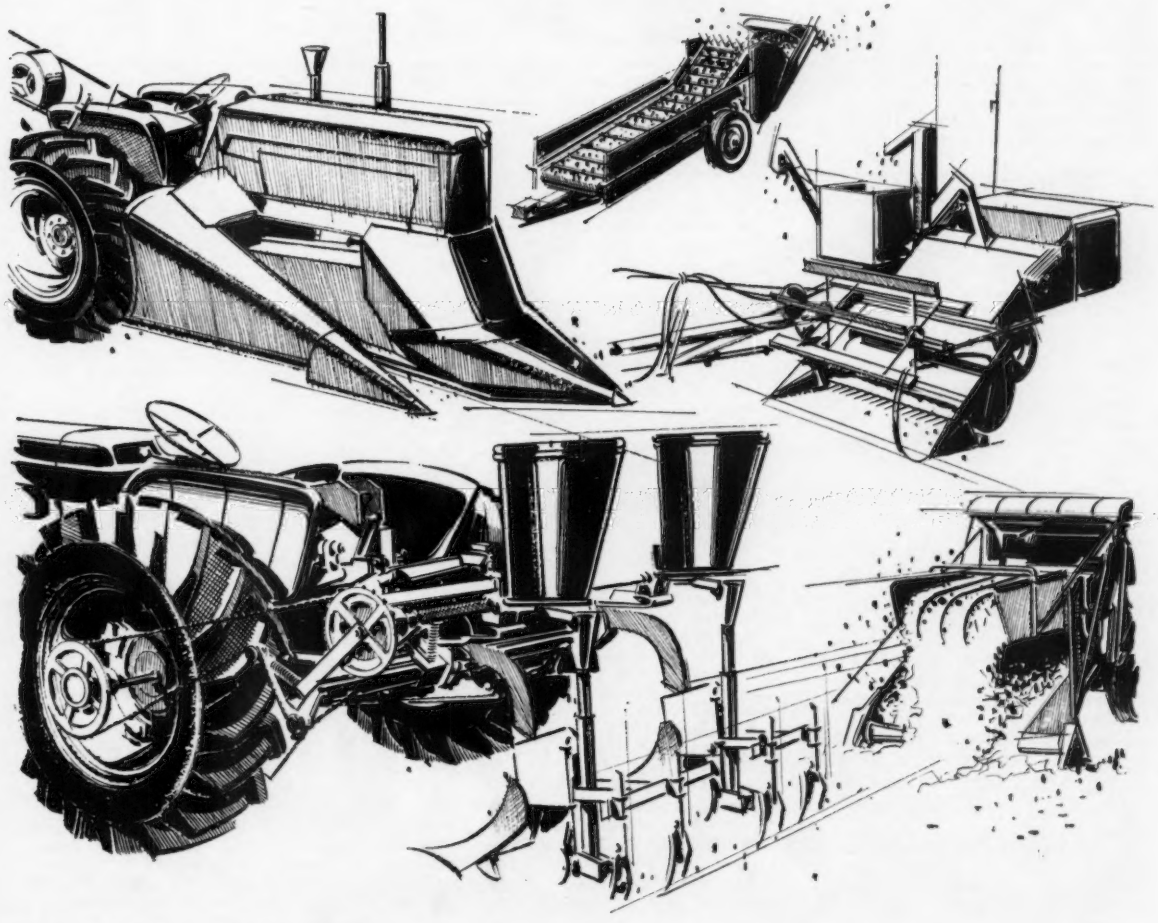

. . . With ASAE Sections

(Continued from page 710)

National President Lloyd W. Hurlbut will be the speaker at the November 4 meeting, which will be held at the University of Maryland, Student Union.

North Atlantic Section

The annual meeting of the North Atlantic Section, characterized by excellent sessions, good attendance and enjoyment for 331 members, families and friends, was held on the campus of the University of Massachusetts, on August 21-24. The outstanding technical program was arranged by the Section chairman, O. C. French, and his program committee, E. L. Arnold, F. R. Hore, B. S. Horne, and R. B. Furry. Dr. and Mrs. R. W. Kleis were general chairmen of local arrangements. National officers in attendance were: President L. W. Hurlbut, Executive Secretary J. L. Butt, Past-President E. G. McKibben, and President-Elect B. T. Virtue.

A full schedule of interesting activities was arranged for the ladies and children during the meeting period. J. T. Clayton organized a social hour for Sunday evening, and L. F. Whitney was responsible for a lobster feed on Monday evening. The meeting concluded on Wednesday with tours of the impressive Quabbin Reservoir project and the Yankee Atomic Electric Power plant.

The following officers for 1960-61 were elected: N. T. Brenner, chairman; W. M. Kalbfleisch, vice-chairman; and H. E. Gulvin, secretary-treasurer. The 1961 meeting will be held on August 20-23 at the University of New Brunswick, under the local arrangements chairmanship of J. A. Roberts, director of agricultural engineering branch.

HIGH LIGHTS OF NORTH ATLANTIC SECTION MEETING

The Tuesday evening, August 23, banquet speaker during the ASAE North Atlantic Section meeting was W. H. Johnson, Farm Credit Banks of Baltimore, who discussed "Farm Financing in the Next Decade"

Nevin T. Brenner *(left)* newly-elected section chairman receives gavel from outgoing chairman, Orval C. French

L. W. Hurlbut, chairman of agricultural engineering, University of Nebraska, and ASAE president *(left)* and J. L. Butt, executive secretary of ASAE, were among national officers in attendance

Orval C. French, head of agricultural engineering, Cornell University, and outgoing section chairman *(left)* visits with Crue M. Sigala-Arevalo of Barquisimeto, Venezuela, South America. Following the meeting, Mr. Sigala-Arevalo plans to travel through eastern United States and Europe, to visit places of interest to agricultural engineers, before returning to South America

EVENTS CALENDAR

October 19-21—*National Society of Professional Engineers* Fall Meeting, Statler-Hilton Hotel, Denver, Colo. Details will be furnished by writing to NSPE, 2029 K St., N.W., Washington 6, D. C.

October 19, 1960 - September 14, 1961—4th *International Course in Hydraulic Engineering,* Delft, the Netherlands. Further particulars may be obtained from the Netherlands Universities Foundation for International Cooperation, 27 Molenstraat, The Hague, Netherlands.

October 26-29 — *International Association of Milk and Food Sanitarians' Annual Meeting,* Hotel Morrison, Chicago, Ill. Write to IAMFS, Room 512, 1145 19th St., N.W., Washington 6, D.C., for additional information.

October 26-31 — *Simposio on the Study and Research of Agricultural Machinery,* Brazil, S. A. For additional information write to: Professor Dr. Hugo de Almfida Leme, Universidade de Sao Paulo, Escola Superior de Agricultura, Luiz de Queiroz, Pracicaba, Brazil, South America.

October 31 - November 2 — *National Fluid Power Assn.* Fall Meeting, Edgewater Beach Hotel, Chicago, Ill. Information may be obtained from NFPA, 5595 N. Hollywood Ave., Milwaukee, Wis.

October 31 - November 5 — 22nd *Dairy Industries Exposition,* International Amphitheatre, Chicago, Ill., under the sponsorship of Dairy Industries Supply Assn. Eight other dairy industry organizations will hold meetings concurrently. Additional information may be had by writing to Dairy Industries Supply Assn., Room 512, 1145 19th St., N.W., Washington 6, D.C.

November 1-4—*Fresh Food Packaging (2nd International Prepacking) Exhibition,* Alexandra Palace, London, England. Further information may be obtained by contacting Brooks Publicity Services, 6 London St., Paddington, London, W. 2, England.

November 13-15 — *Mid-America Lawn, Garden and Outdoor Living Trade Show,* Navy Pier, Chicago, Ill. Details may be obtained by writing to Ted Black Agency, Medical Arts Bldg., Reading, Pa.

November 14-16—*National Warm Air Heating and Air Conditioning Association 1960 Convention,* Statler-Hilton Hotel, Cleveland, Ohio. Further information may be obtained from NWAHACA headquarters, 640 Engineers Bldg., Cleveland 14, Ohio.

November 14-16 — *Structural Clay Products Institute Annual Convention,* Diplomat Hotel, Hollywood, Fla. Write to SCPI, 1520 18th St., N.W., Washington 6, D.C., for details.

November 14-18—*National Electrical Manufacturers Assn.* Annual Meeting, Traymore Hotel, Atlantic City, N. J.

November 15-17—*Building Research Institute Fall Conferences,* Shoreham Hotel, Washington, D. C. Further details may be obtained from BRI, 2101 Constitution Ave., Washington 25, D. C.

November 18-24 — *Farm-City Week.*

December 12-15 — First *Industrial Building Exposition and Congress,* New York Coliseum. Information may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York, N. Y.

January 9-13 — *International Congress and Exposition* of the *Society of Automotive Engineers,* Cobo Hall, Detroit, Mich. Contact SAE, 485 Lexington Ave., New York 17, N. Y., for additional information.

February 5-11 — *National Electrical Week.*

March 2-7 — *International Technical Congress of Agricultural Machinery,* Paris, France. For information write to: Congres International Technique du Machinisme Agricole, 19, Rue Jacques Bingen, Paris XVII, France.

March 7-12—*32nd International Machinery Show,* Paris, France. For additional details write to Robert de Wilde, agricultural attache, 1001 Connecticut Ave., N.W., Washington 6, D.C.

April 17-19 — Eighth *National Watershed Congress,* Ramada Inn, Tucson, Ariz. Details may be obtained from The National Association of Soil Conservation Districts, League City, Texas.

June 9-17 — *European Congress of Chemical Engineering and ACHEMA Congress,* Frankfurt am Main. Information is available from DECHEMA, Frankfurt am Main 7, Postfach.

June 25-30 — *American Society for Testing Materials Annual Meeting,* Chalfonte-Haddon Hall, Atlantic City, N. J. Write to ASTM headquarters, 1916 Race St., Philadelphia 3, Pa., for information.

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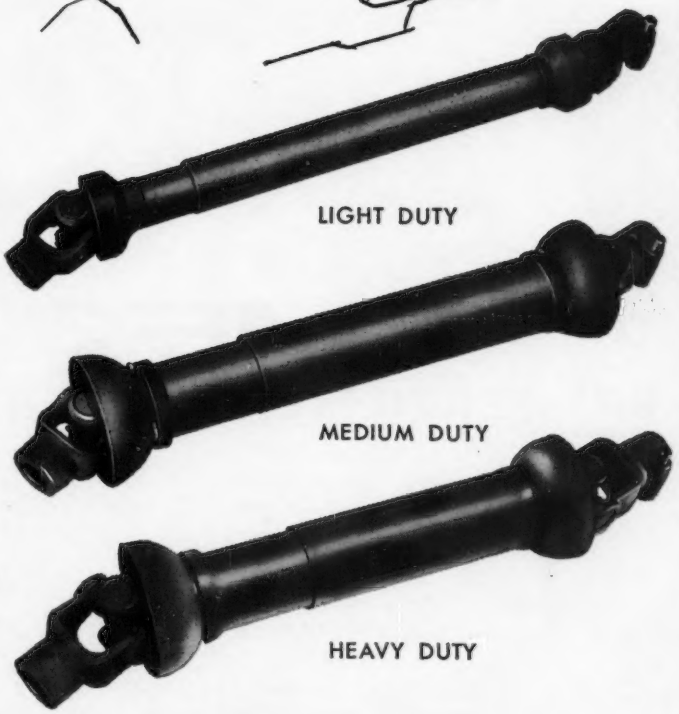

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The following bulletins have been released recently. Copies may be obtained by writing to author or institution listed with each.

An Appraisal of Agricultural Research . . . and the Road Ahead. Agriculture Information Bulletin No. 221. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. Price, 20 cents.

Floods of January-February 1959 in Ohio, by W. P. Cross and H. P. Brooks. Geological Survey Circular 418. U. S. Geological Survey, Washington 25, D. C.

Operation Adjustments and Troubles of Combine Harvester, by P. D. Hadjigeorgiou. 1960. Agriculture Office, British Direction of Mechanical Cultivation Service, Salonika, Greece.

Farm Silos, by J. R. McCalmont. ARS, USDA Miscellaneous Publication No. 810. April, 1960. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price, 20 cents.

Weed Control Equipment and Methods for Mechanized Cotton Production. Southern Cooperative Series, Bulletin No. 71. April, 1960. Mississippi Agricultural Experiment Station, State College, Miss.

Wood Beams for Farm Structures, by J. E. Dixon and Everett H. Davis. Bulletin No. 324. February, 1960. Idaho Agricultural Extension Service, College of Agriculture, University of Idaho, Moscow.

Concrete Pipe for Irrigation in Hawaii, by Bessel D. van't Woudt. Circular 57. December, 1959. Agricultural Experiment Station, College of Agriculture, University of Hawaii, Honolulu.

Using Water Pumps for Gathering Maple Sap, by Earl L. Arnold. Bulletin 616. April, 1960. Agricultural Experiment Station, University of Vermont and State Agricultural College, Burlington.

The Harvester. 1957 and 1958 issues. This is the official organ of the Agricultural Engineering Society, Indian Institute of Technology, Kharagpur, India, and records the agricultural engineering work done in India.

Determining Irrigation Requirements from Consumptive Use Water Rates, by Harry F. Blaney. Reprinted from the Transactions of the Fifth International Congress of Agricultural Engineering — 1958. Western Soil and Water Management Research Branch, ARS, USDA, 215 W. Seventh St., Los Angeles 14, Calif.

Current Concepts and Developments in Rainfall Erosion Research in the United States, by Dwight D. Smith and Walther H. Wischmeier. Reprinted from the Transactions of the Fifth International Congress of Agricultural Engineering — 1958. D. D. Smith, agricultural engineer, Agricultural Research Service, USDA, Plant Industry Station, Beltsville, Md.

What's New in Farm and Home Publications for Kansas. Spring, 1960. Extension Service, Kansas State University, Manhattan, Kans.

Recent Yields of Wood Research Laboratory of Virginia Engineering Experiment Station, by E. George Stern. Bulletin No. 41. July, 1960. Wood Research Laboratory, Virginia Polytechnic Institute, Blacksburg, Va.

The following pieces are available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.:

50 Years of Service Through Wood Research. Miscellaneous Publication No. 820, Forest Service, USDA. April, 1960. Price, 15¢.

Bunker Silo Type "E" — Plan No. 5865. Miscellaneous Publication No. 815, USDA. April, 1960. Price, 5¢

Milking Plant . . . U Type — Plan No. 5736. Miscellaneous Publication No. 817, USDA. March, 1960. Price, 5¢.

Milking Plant, Herringbone Type — Plan No. 5868. Miscellaneous Publication No. 818, USDA. April, 1960. Price, 5¢.

4,000-Bushel Sweetpotato House — Plan No. 5648. Miscellaneous Publication No. 822, USDA. June, 1960, Price, 5¢.

Sprinkler Irrigation, by Paul H. Parr. July, 1960. Price, 10¢.

A Small Country Elevator for Merchandising Grain, by Heber D. Bouland. Marketing Research Report No. 387. June, 1960. Price, 35¢.

Sproeien als middel tegen nachtvorstschade (Frost Protection by Sprinkling), by Ir. J. De Zeeuw, Bulletin No. 46, Instituut Voor Tuinbouwtechniek, Wageningen, The Netherlands.

The two following bulletins are available from the Agricultural Experiment Station, Kansas State University, Manhattan:

What It Costs to Use Farm Machinery, by G. H. Larson, G. E. Fairbanks, and

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F. C. Fenton. Bulletin 417. April, 1960.

Results from the Concordia, Kans., Irrigation Experiment Field—1953-57. Bulletin 421. April, 1960.

35th Annual Report of the Kansas Committee on the Relation of Electricity to Agriculture. 1959. Agricultural Engineering Dept., Kansas State University, Manhattan.

A Bibliography of Farm Buildings Research—1945-1958; Part II Buildings for Potato Storage. 1960. The Agricultural Research Council, 15 Regent St., London, S.W. 1, England. Price, 2s. 0d.

Bulk Milk Cooling, by Earl L. Arnold, Henry V. Atherton, Alec Bradfield, Wendell I. Carr, Edwin C. Schneider, and Andrew Tessmann. Brieflet 934. Revised May, 1960. Vermont Agricultural Extension Service, University of Vermont and State Agricultural College, Burlington, Vt.

The following three bulletins on Colorado's ground-water problems are available from Colorado State University Experiment Station, Fort Collins, Colo.:

Ground-Water in Colorado. Bulletin 504-S. August, 1959.

Water and the Law. Bulletin 505-S. January, 1960.

The Economic Picture. Bulletin 506-S. June, 1960.

A Vacuum System for Removal of Lungs and Other Waste Products from Broilers, by Roger Walters, K. N. May, and F. E. Henry. Circular N.S. 17. July, 1960. University of Georgia, College of Agriculture, Experiment Station, Athens, Ga.

The two following bulletins are available from Cooperative Extension Service, Agriculture and Home Economics, University of Kentucky, Lexington:

More Money by Improving Curing Conditions for Burley Tobacco, by Ira Massie and Kermit Mills. Leaflet 234.

Drying Small Grain and Shelled Corn, by Kermit Mills and J. B. Kelley. Circular 569.

The Value of Dairying. Area Development Section, Louisiana Power & Light Co., New Orleans 14, La.

New Trends in Lighting, by D. W. Works. Farm Electrification Leaflet No. 50. Extension Division, University of Idaho, College of Agriculture, Moscow, Idaho.

The two following bulletins are available from Agricultural Research Service, USDA, Plant Industry Station, Beltsville, Maryland:

A Progress Report on Harvesting and Handling Concord Grapes, by S. L. Hedden, J. H. Levin, and H. P. Gaston. No. ARS 42-42. July, 1960.

Corn Topping—Its Effect on Field Drying and Harvesting, by T. W. Casselman, J. L. Schmidt, and W. G. Lovely. No. ARS 42-44. August, 1960.

Leaky Artesian Aquifer Conditions in Illinois, by William C. Walton. Report of Investigation 39. 1960. Illinois State Water Survey, Urbana, Ill.

1959 Annual Report. International Institute for Land Reclamation and Improvement, Wageningen, The Netherlands.

Standard Heating Requirements for the Commercial Storage of Sweet Potatoes, by S. M. Blount, Jr. Facts for Industry Series, Bulletin No. 12. February, 1960. The Industrial Experimental Program, School of Engineering, North Carolina State College, Raleigh, N. C. Price, $1.00.

Fertilizer Grade Ammonium Nitrate. Revised July, 1960. Manufacturing Chemists' Association, Inc., 1825 Connecticut Ave., N.W., Washington, D. C. Price, 50¢

as much yours as though they came off your own board

CUSTOM ENGINEERED

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AVAILABLE MODIFICATIONS

FUEL SYSTEM — gasoline, natural gas or LPG (for domestic use) and alcohol, kerosene, or No. 1 fuel oil (for export).

ELECTRICAL EQUIPMENT — electric starter-generator system or electric starter only for all models. Solenoid switches and automatic choke, for remote or automatic starting, also available.

HYDRAULIC POWER — all Wisconsin V4's can be equipped with integrally-mounted hydraulic pump.

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DIRECT DRIVE — special crankshaft extensions are available threaded, tapered, splined, special diameters and lengths, various keys, etc., for close-coupled pumps, generators, and other equipment.

SAFETY DEVICES — low-oil-pressure cut-off switch for 2- and 4-cyl. models, and high-temperature safety switch for all models.

OTHER ACCESSORIES — automotive and spark-arresting mufflers, pre-cleaners, drive pulleys for flywheel, and rewind starters for ACN and BKN engines.

Do you have a special power problem? If you do, you can save development time and cost by letting Wisconsin help you solve it — with *custom-engineered* modifications to meet your particular installation requirements down to the smallest detail.

Our "spec" engineers are power specialists, backed by over 50 years of engine specialization. They can draw on a wealth of problem-solving experience in every field of engine-power application. Their counseling is part of Wisconsin custom-engineering service — and it doesn't cost you a red cent.

For best results, consult our engine specialists during the preliminary and design stage of your product development. In the meantime, send for Bulletin S-249 and familiarize yourself with the entire Wisconsin line of air-cooled engines — 3 to 56 hp. Write Dept. O-40.

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World's Largest Builders of Heavy-Duty Air-Cooled Engines

ANNUAL MEETING AWARD WINNERS

Due to the shortage of space in previous issues the Annual Meeting Award Winners other than the gold medalists were not carried. Following are Student Honor, Journal Paper and Extension Blue Ribbon winners announced at the 53rd Annual ASAE Meeting held at Columbus, Ohio, in June.

Student Honor Awards

The Student Honor Awards are made to recognize outstanding scholarship attainments and general participation in student activities. Recipients are elected by their respective ASAE Student Branches. The award consists of a certificate and gold key. The following student branch members of ASAE were elected to receive the Award in 1960: William K. Andersen, University of Idaho; Charles W. Boning, Washington State University; Carl D. Carpenter, University of Missouri; Willie T. Chevalier, Louisiana Polytechnic Institute; George H. Comer, Virginia Polytechnic Institute; Harry E. Cooper, Pennsylvania State University; Larry Delfs, Iowa State University; Kirk Dimmitt, Washington State University; Clayton Enix, Colorado State University; Raymond W. Evans, Jr., Pennsylvania State University; Thomas M. Flowers, University of Arkansas; Richard Fluck, North Carolina State College; Llye E. Funkhouser, University of Illinois; Richard Gentry, Texas Technological College; Donald R. Gradwohl, University of Idaho; Robert C. Hansen, Ohio State University; Thomas L. Hanson, Iowa State University; Richard D. Holdren, Ohio State University; Duane A. Howell, Iowa State University; Larry F. Huggins, University of Illinois; Herman F. Jasper, Kansas State University; Waldo D. Lang, Kansas State University; Cliffton A. Maguire, Iowa State University; Charles R. Norris, University of Missouri; James A. Reese, University of Minnesota; Robert C. Rice, Colorado State University; Walter N. Stumpf, University of Minnesota; Gary L. Wells, University of Illinois; Lawrence H. Wetter, Kansas State University; Luther Wilhelm, University of Tennessee; Daniel L. Bruehl, Jr., Oklahoma State University; and Myron D. Simons, Oklahoma State University.

Journal Paper Awards

Following are the top ten papers published in AGRICULTURAL ENGINEERING during 1959, as judged by the Committee on Journal Paper Awards — J. E. Harmond (chairman), G. A. Karstens (vice-chairman), T. O. Hodges, G. W. Isaacs, and H. Matson. The ASAE members who were authors of the five winning papers will receive a certificate and a one-year's paid-up membership in the Society, and the "honorable mention" group will receive a certificate. The five winning papers in order of highest scoring are: "Effect of Tractor Operation on Human Stresses," by Heinrich Dupuis (September); "Glass-Fiber Plastics in Farm Building Construction," by Robert A. Aldrich and James S. Boyd (June); "Factors Affecting the Pelleting of Hay," by J. L. Butler and H. F. McColly (August); "Criteria for the Design and Development of Farm Equipment," by Russell R. Raney and Karl D. Butler (March); and "Hydrograph Synthesis for Small Arid-Land Watersheds," by R. B. Hickok, R. V. Keppel, and R. B. Rafferty (October). Those receiving "honorable mention" are: "Machine and Method Efficiency in Combining Wheat," by William H. Johnson (January); "Developments in Pelleting Forage Crops," by H. D. Bruhn, Arnold Zimmerman, and R. P. Niedermeier (April); "Swine Growth and Efficiency in a Naturally Varying Environment," by T. E. Hazen, N. H. Curry, and H. Giese (April); "Air-Flow Measurement in Crop Driers," by F. H. Buelow (April); and "Steering-Force Requirements of Wheel Tractors," by J. B. Liljedahl, R. Gluck, and M. E. Schroeder (September).

Blue Ribbon Awards for Annual Meeting Exhibits

Public service and industrial organizations from all parts of the country displayed exhibits at the 1960 Annual ASAE Meeting with classifications including: Extension methods; publications; slides and film strips; radio and television; motion pictures; and demonstration models.

The blue ribbon winners for extension methods were: Burton Horne, Pennsylvania State University for pasture renovation demonstrations; Curtis Johnson, University of Massachusetts, for mastitis program; and R. B. Furry, Cornell University, for dairy barn workshops.

In the industrial periodicals class for publications, the winner was Portland Cement Association with its publication, "Rural Concrete Builder." The University of Massachusetts was the winner in the public agency periodical classification group for its periodical, "Agricultural Engineering." Winner in the industrial bulletins classification was W. Everett Eakin, Libby-Owens-Ford, for a bulletin entitled "From Cradle to Gravy," while the winners in the public agency bulletins class were: C. L. Hill, Purdue University, for a bulletin on minimum tillage; Richard G. Pfister and Raymond M. Clark, Michigan State University for a bulletin on farm fire safety demonstrations; and G. E. Henderson and C. E. Turner, University of Georgia, for a bulletin entitled "Tractor Operation and Daily Care."

In the slides and film strips category, W. R. Schnug and W. E. Stuckey, Ohio State University, were winners in the public agency division for "A Day in the Life of J. Oker," as well as A. J. Muehling, University of Illinois, for "Installation of Heating Cable for Swine." W. Everett Eakin, Libby-Owens-Ford won with his entry of "Path to Greater Farm Profits" in the industrial classification of slides and film strips.

The radio and television classification winner was Donald P. Brown, Michigan State University, for "Progress Through Agricultural Engineering" and "Electricity at Work."

Winners of the motion picture awards in the public agency class were: Motion Picture Service, USDA, for movies entitled "Breakthrough" and "The REA Story;" and the agricultural engineering department, Iowa State University, for a movie entitled "A House Warming Electrically." In the industrial classification, winners included: Plant Food Institute for "Cash in on Grass;" and Portland Cement Association for "The Pageant of American Farms."

Public Agency class winner for demonstration models was Don Jedele, University of Illinois, for his model on swine finishing layouts. The winner in the industrial category was Ivan Bigalow, U. S. Steel Corp., for a model entitled "Fence is a Farm Production Tool."

. . . News

(Continued from page 706)

more particularly help to under-equipped countries which are undergoing development. In the course of the five sessions, of one-half day each, agricultural engineering personalities of all countries will present papers written in one of the following languages: English, French, German, and Russian. Further information may be obtained by writing to Secretariat General, 19, Rue Jacques Bingen, Paris, 17e, France.

Granular Materials Application Workshop

The Agricultural Chemical Application Committee of ASAE will hold a Granular Materials Application Workshop meeting on November 3 and 4, at the LaSalle Hotel, Chicago, Ill., to consider problems in the industry. It is planned to bring together representatives of the manufacturers of agricultural chemicals and application equipment and research workers concerned with the problems. Further information may be obtained by writing to Frank Irons, chairman, Agricultural Chemical Application Committee, Agricultural Engineering Building, Ohio Agricultural Experiment Station, Wooster, Ohio.

International Conference on Soil-Vehicle Systems

The First International Conference on the Mechanics of Soil-Vehicle Systems will be held in June of 1961 at Turin, Italy. The conference is being organized by the Turin Institute of Technology in cooperation with the Universities of Milan, Bologna, Rome, and Naples, under the auspices of the Italian Army, Italian National Research Council, and the U.S. Army Office of Ordnance Research, Duke University. The purpose of the conference is to discuss, on an international forum, the present concepts of the mechanics of land locomotion, as well as their engineering aspects. Its character will be that of a scientific-engineering international congress of four to five days duration. Further information may be obtained by writing to: M. G. Bekker, national secretary, First International Conference on the Mechanics of Soil-Vehicle Systems, U.S. Army Ordnance Tank-Automotive Command, 1501 Beard, Detroit 9, Michigan.

Transactions of Vth CIGR Available

The Transactions of the Vth International Congress of Agricultural Engineering — 1958 are now available. They are published in two volumes 6¾ x 9½ in., with 1586 pages and 285 figures. Subjects are arranged in the following manner: First section — the sciences of soil and water with application in the field of agricultural engineering; second section—farm buildings and connected equipment; third section — agricultural machinery and rural electrification; and fourth section—farm work and processing program. The two volumes are available at the rate of 850 Belgian Francs (including postage and packing) by transfer to Postal Cheque Account nº 6574 74 of "Ve Congres International de Genie Rural" Gembloux (Belgique). For further information, contact Mr. Laret Nestor, Treasurer, Avenue des Combattants, 69, Gembloux (Belgique).

Texas Tech Names Outstanding AE Student

Kenneth Henry of Muleshoe, Texas, has been named outstanding agricultural engineering student of 1960 at Texas Technological College (Lubbock). To commemorate this honor, he has been given the first annual William F. Schwiesow Award. He is a 23-year-old senior who plans to finish degree work in January. In addition to receiving a personal plaque, his name has been engraved on a large wall plaque, which will be placed in the college agricultural engineering building.

The award is named in honor of Assistant Professor Schwiesow, advisor of the college student branch of the American Society of Agricultural Engineers. The honor goes to the student who has made the best all-around contribution to the ASAE Student Branch activities during the academic year. The Schwiesow Award is made possible through contributions of Student Branch members and alumni.

. . . ASAE Member News

(Continued from page 708)

neering, manufacturing and sales activities involved in the planning and development of new or re-engineered products.

R. W. Hough, divisional product supervisor, wheel tractors and industrial equipment, started with the company in 1940 at the Syracuse, N. Y., district office and progressed through the sales organization to the position of general supervisor, farm tractor sales, in 1959.

F. M. Farleigh, divisional product supervisor, tillage, seeding, and farm materials handling equipment, started his service in the firm's Portland, Ore., district office in 1939 and progressed to the position of general supervisor, tillage and implement sales, in 1959.

R. L. Green, head, agricultural engineering department, University of Maryland, has been named chairman of a special Committee to Study Shore Erosion by the governor of Maryland, Millard E. Tawes. Maryland's shore line is estimated as being more than 2,000 miles in length. It has also been estimated that some 300 acres per year are being lost through shore recession.

Dennis L. Moe, head of the agricultural engineering department, South Dakota State College, Brookings, through special invitation from the General Motors Corp., attended the General Motors Conference for Engineering and Science Educators July 10-22. The conference was held at the Technical Center of General Motors in Detroit, Mich. He reports that this is the first time that South Dakota has had a representative at this conference and that only one agricultural engineer has attended prior to this year.

Biswa N. Ghosh has recently resigned his position of design analysis engineer in the product engineering department of the International Harvester Co. (G.B.) Ltd. at Doncaster, U. K., to join the Overseas Civil Service (Research Branch) of the British Government in Nairobi, Kenya. In his position as agricultural research engineer with the East African Industrial Research Organization, covering the territories of Kenya, Uganda, and Tanganyika, he will be responsible for conducting research into the drying and storage problems of various crops, such as coffee, sisal, pyrethrum and papain. In addition, he will look after the general agricultural engineering interests of the organization.

Woodrow W. Hare, formerly assistant agricultural engineer, University of Georgia, Athens, is now a field representative with the American Zinc Institute.

Jesse L. Hicks has been transferred from the USDA, Soil Conservation Service, watershed project office in Greenville, Tenn., to the SCS office in Durham, N. H. He now holds the position of state conservation engineer.

Frederick M. Hoppert has accepted the position of general manager with Milwaukee Sprayer Mfg. Co., Inc., Milwaukee, Wis. He previously was manager of customer service, metal buildings division, Inland Steel Products Co., of Milwaukee, Wis.

Joseph R. Jones is now located in Lamesa, Texas, where he is sales engineer for Bruton Manufacturing Co. Formerly, he was an agricultural engineering instructor at the Texas Technological College in Lubbock, Texas.

William B. Land, rural engineer for the Georgia Power Co. in Columbus, Ga., has been transferred to its Valdosta, Ga., office as division rural engineer.

Charles G. McKiel advises that he has recently become a member of the University of Rhode Island (Kingston) staff as an instructor in the mechanized agriculture department. He previously was an agricultural engineer with Red River Valley Potato Research Center, Agricultural Marketing Service, USDA, at Grand Forks, N. D.

Dean M. Morgan, in market development for Caterpillar Tractor Co., has been transferred from Peoria, Ill., to Hayward, Calif., where he is special agriculture representative for the company.

J. M. Patterson, senior project engineer for the John Bean Division, Food Machinery and Chemical Corp., Lansing, Mich., has been transferred to the company's Speed Sprayer Plant in Orlando, Fla., as chief engineer.

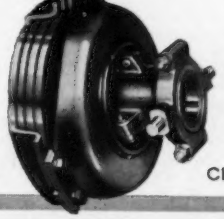
Don E. Sharp, formerly in sales work at Armour Agricultural Chemical Co., Nashville, Tenn., is now an agricultural engineer with the Soil Conservation Service, USDA, in Tennessee.

Robert E. Strohman advises that he has accepted a position as project engineer with the John Bean Division of Food Machinery and Chemical Corp., Lansing, Mich. He formerly was product design and research engineer with the Rockford Works of J. I. Case Co. at Rockford, Ill.

Gerald C. Zoerb has accepted a position as associate professor in the agricultural engineering department of the University of Saskatchewan, Saskatoon, Sask., Canada. He previously was associate professor of agricultural engineering at South Dakota State College, College Station.

John N. Walker has been promoted to the position of director of the physical plant at the University of the Philippines, Quezon City.

EXTRA ENGINE ON A TRACTOR?



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1960 Winter Meeting

(Continued from page 706)

In addition to an address of welcome, the General Session will feature two nationally prominent speakers. Dr. A. B. Kinzel, president of Engineers Joint Council, will discuss "EJC and Its Relationship to ASAE" and will explain the importance of EJC to the engineering profession. Mr. Wheeler McMillen, vice-president, Farm Journal, Inc., will speak on public relations in agriculture. This is a subject of special value and importance to agriculture and agricultural engineers at the present time.

In addition to the general sessions, there will be five one-half day sessions during which five or more concurrent technical sessions will be presented. Subjects, ranging from tractor design, chemical application, automation in farm building construction to materials handling, foraging, cotton harvesting, drainage, irrigation, and hydrology, will be presented. There will be sessions on soil erosion, farm wiring, crop culture, and poultry housing. There will also be periods devoted to discussion of radiation, solar energy, environmental control, testing and analysis, and farm wiring, to mention a few.

MANUFACTURERS' LITERATURE

Literature listed below may be obtained by writing the manufacturer.

Heavy Duty Transmissions

Cotta Transmission Co., Rockford, Ill. — An 8-page brochure entitled "Heavy Duty Transmissions" describe transmissions with input torque capacities of 150 to 2,500 ft-lb. Examples of standard single speed, multiple speed, and right-angle drives are illustrated, with complete lists of input torque capacities, speeds, and gear ratios. Also included are various transmission arrangements for rotation, location, speed, multiple speeds, shifting, cooling, mounting, clutches, and output shafts.

Belt Conveyor Idler Bulletin

Joy Manufacturing Co., Henry W. Oliver Bldg., Pittsburgh 22, Pa. — Bulletin LD-111, a 20-page booklet on the belt conveyor idler, lists complete specifications; gives a detailed description of construction features, application instructions, and an explanation of advantages; and shows installation photographs.

Two-Way Radio Bulletin

General Electric Co., Communication Products Dept., P.O. Box 4197, Lynchburg, Va. — A 24-page bulletin, No. ECR-497B, shows communication equipment available for businesses, and contains sections covering amplifiers, portable hand-carried two-ways, desk-type base stations, floor-mounted units, selective-calling, antennas, microphones, remote control, and pocket voice message receivers. It also describes frequency allocations and the various combinations of two-way radio possible in each frequency. Also shown is the difference between tubed equipment and transistorized models.

Industrial V-Belt Design Catalog

The Boston Woven Hose & Rubber Division of American Biltrite Rubber Co., Box 1071, Boston 3, Mass. — A 64-page industrial V-belt design catalog features pre-engineered data and has been created so that the pre-engineered tables are much easier to use than previous editions. In addition to general information, V-belt drive selection tables, horsepower rating tables and matching data, and helpful product information is included.

Customers' Guide for Instruments

Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif. — It is the purpose of 37-page customers' guide to indicate the scope of product lines and to assist the buyer in contacting the proper outlet for the products he seeks. It is a directory to company's divisions, products, sales locations, and service facilities.

Non-Freezing Water Draw-off Valves

The Johnston & Jennings Co., 4700 W. Division St., Chicago 51, Ill. — A 2-page bulletin, No. 500-2-1, describes and illustrates with photos and diagrams the non-freezing water draw-off valves. It also lists dimensions and specifications.

Dusting Shield Brochure

Forrest City Machine Works, Inc., Forrest City, Ark. — A 2-color brochure provides information and illustrations on dusting shields designed for use in any row-crop area and for mounting on: small, large, high clearance, and single front-wheel tractors. A parts list is also included.

Motors Literature

U. S. Electrical Motors Inc., Box 2058 Terminal Annex, Los Angeles 54, Calif., offers the following literature pieces:

Bulletin No. F-1974 is a 4-color brochure outlining and illustrating the 8-plus values of the company. It also contains a map showing locations of the major plants, sales and service offices and distributors, and truck routes.

An 8-page, 4-color brochure explains briefly the Varidyne controlled speed system principle. Illustrated are a wide range of machine applications, a wide selection of special effects, and a wide selection of controls available. Schematic drawings of a few types of Varidyne applications are also presented, as well as photographs in established applications.

An 8-page, 4-color brochure, No. F-2000, on submersible pump motors for deep well and booster water pumping service contains cutaway drawings showing construction details of special features of submersible motors for 6, 10, and 14 in. well diameters and explains the water-filled operating principle as opposed to the oil-filled principle.

Polyethylene Film Swatch Book

The Kordite Co., Department "A," Macedon, N. Y. — This film swatch book is a 5-page brochure describing complete range of polyethylene film stock sizes, with recommended uses and applications — including nurseries, industry, farm tarpaulins, store counter covers, and many others. Individual swatches of both clear and opaque polyethylene film are attached for easy examination and reference by the user.

Tractors, Equipment for Construction

Tractor and Implement Div., Ford Motor Co., Industrial Tractor and Equipment Sales Dept., 2500 E. Maple Rd., Birmingham, Mich. — A 4-color, 16-page booklet, entitled "Ford Tractors, Equipment for Construction," shows 33 action photos, including loaders, backhoes, dozers, earthcavators, fork lifts, cranes, and other industrial equipment, in use with tractors. The applications described include: Heavy and light excavating; heavy and light loading; scraping, leveling and grading; and lifting, towing and general utility.

Throttle Valves Bulletin

Hose Accessories Co., 2720 N. 17th St., Philadelphia 32, Pa. — A 4-page, 2-color bulletin, No. 460, illustrates and describes throttle valves for the safe control of compressed air on pneumatic operating equipment for mining, contracting, construction, tunneling, quarrying and general industry applications.

Ditcher Features New Transmission

Barber-Greene Co., 400 N. Highland Ave., Aurora, Ill. — A 4-page, 2-color bulletin illustrates and describes the hydra-crowd transmission for use with wheel ditcher.

Haying Equipment Brochure

Ray Cunningham & Sons, Inc., LaCrosse, Wis. — A 12-page, 4-color brochure illustrates and describes complete line of haying equipment, including three different models of hay conditioners, a side delivery rake and a roto-tedder.

Electric Motors Literature

Sterling Electric Motors, Inc., 5401 Telegraph Rd., Los Angeles 22, Calif., offers the following literature:

An 8-page, 2-color bulletin, No. 198, describes and illustrates the features of the slo-speed gear motor and slo-speed separate motor reducers, as well as the basic types and many modifications, and the mounting positions in which these units may be used.

Catalog No. 200, a 56-page piece, deals with multi-shielded a.c. motors and includes complete pricing and dimensional data on motors of this type, ranging from ¼ to 200 hp. Information is given for various modifications, such as specialized mountings and enclosures, as well as on the multi-shielded drip-proof motors. Also included is a motor selection and application section.

Farm Equipment Literature

Allis-Chalmers Manufacturing Co., Farm Equipment Div., Milwaukee 1, Wis., offers the following literature pieces:

No. TL-2226 gives data on design, construction and use of the standard model roto-baler and the fast-wrap model with overdrive.

No. TL-2248 describes and illustrates the model 95-G spreader.

No. TL-2257, entitled "Keep Rolling" gives information on the gleaner combines.

No. TL-2271 illustrates and describes the various models of corn pickers and snappers.

No. TL-2181 includes design and construction features of crawler tractors and tells pictorially the agricultural usage story by both single tractor owners and big fleet operators.

Caterpillar Literature

Caterpillar Tractor Co., Peoria, Ill., offers the following pieces of literature:

Form 20185-DN935, a 28-page handbook entitled "Judging Engine Quality," discusses design, material, workmanship, reliability, cost of operation, parts and service availability and trade-in or resale value of engines.

Form 33705, a 2-color, 8-page booklet entitled "Farm Easier . . . Farm Better," describes and illustrates the application of track-type tractor power on the farm. Brief specifications of crawlers are also included.

Form 33708, a 12-page, 2-color booklet entitled "Best by Job Test," features reports from scraper and dozer owners who have used various types of cutting edges in material ranging from rock and gravel to highly abrasive sand. It describes and illustrates various edges and lists multi-section part numbers.

Form D013, a 12-page, 2-color booklet entitled "From Plan to Profit," tells of the earthmoving equipment needed for the soil and water conservation work, and describes and illustrates equipment used on parallel terracing, protected waterways, and land forming projects.

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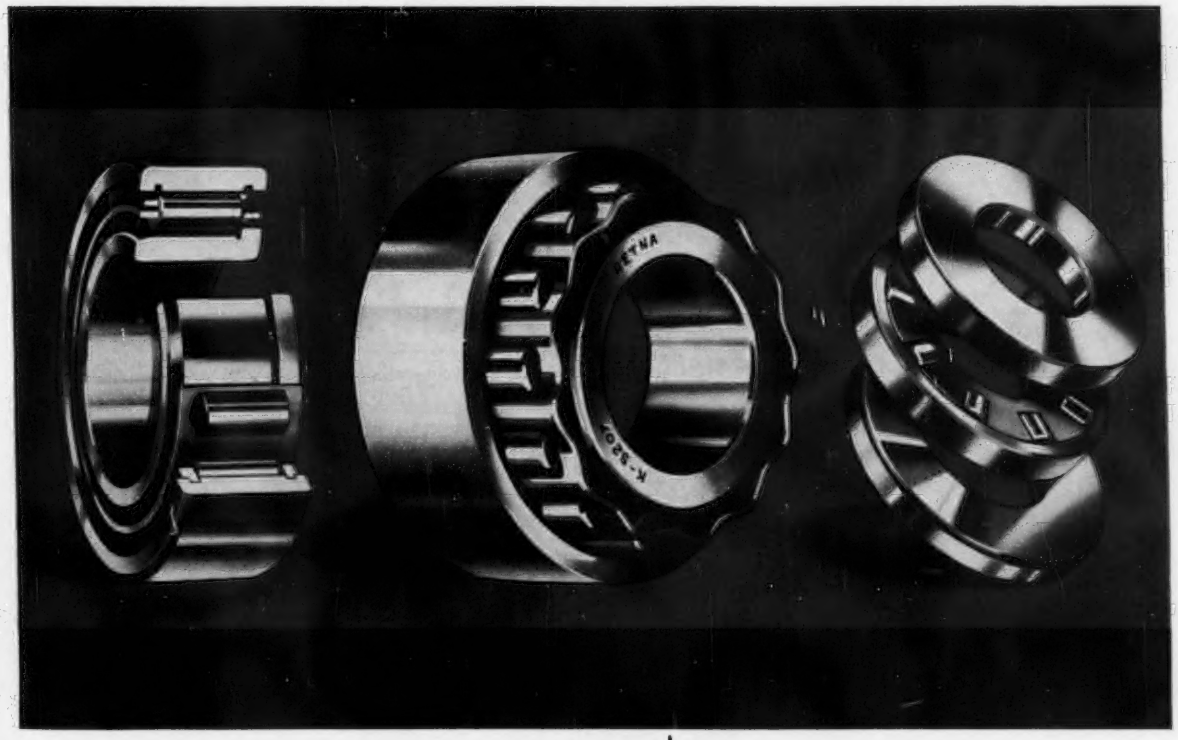
What would you pay for greater bearing efficiency?



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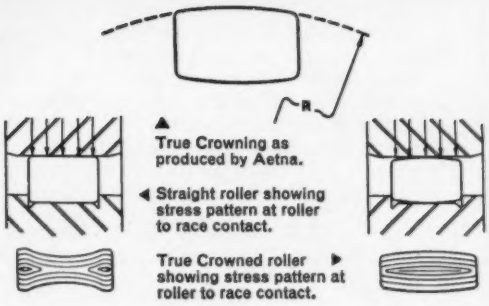
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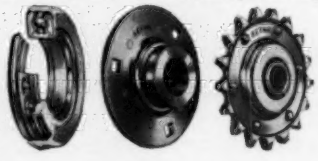
◀ Straight roller showing stress pattern at roller to race contact.
True Crowned roller ▶ showing stress pattern at roller to race contact.



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Agricultural Engineers' Handbook

By C. B. RICHEY, *Tractor and Implement Division, Ford Motor Company, Dearborn, Michigan;* Carl W. Hall, *Michigan State University;* and Paul Jacobson. Ready in January.

This long-awaited handbook for professional agricultural engineers presents, under one cover, the theory and practice involved in the problems of agricultural production which are the concern of the agricultural engineer. The engineering approach is used throughout, but the style is simple and clear enough to allow comprehension by non-engineer readers of all but the most technical portions. Careful editing of contributed material has maintained conciseness, clarity, and the analytical approach throughout.

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√ **Basic agricultural data — livestock, soil and climate.**

This book will be a valuable adjunct to all current agricultural engineering texts because of its wealth of new materials in all fields. Of value and interest to students as a reference during study and after graduation, this book will also be of great use to professional farm managers, agricultural extension workers, farm machinery dealers, electric power company field personnel in agricultural areas, and others.

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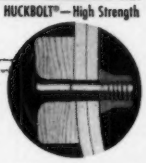

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- Design and improvement of farm buildings
- Engineered improvements for soil and water conservation and use
- Creating applications for electricity in farm practice and living—

then you can derive much benefit from membership in ASAE, and the Society cordially invites you to make application. For further information write

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS
St. Joseph, Michigan

1959 Supplements to 1958 Book of American Society for Testing Materials Standards. 10 parts. Paper. Available from ASTM, 1916 Race St., Philadelphia 3, Pa. Price, $4.00 per part or $40.00 per complete set of 10 parts.

The book of ASTM Standards is published triennially with Supplements in the intervening years. Each part-supplement brings up to date the corresponding part of the 1958 book of Standards by including new standards and revisions adopted in 1959. The ten parts include: Part 1 — Ferrous metals specifications; Part 2 — Nonferrous metals specifications; Part 3 — Methods of testing metals; Part 4 — Cement, concrete, mortars, road materials, waterproofing, soils; Part 5 — Masonry products, ceramics, thermal insulation, sandwich and building constructions, acoustical materials, fire tests; Part 6 — Wood, paper, adhesives, shipping containers, cellulose, leather; Part 7—Petroleum products, lubricants, tank measurements, engine tests; Part 8 — Paint, naval stores, aromatic hydrocarbons, coal, coke, gaseous fuels, engine antifreezes; Part 9 — Plastics, electrical insulation, rubber, carbon black; and Part 10 — Textiles, soap, water, atmospheric analysis, wax polishes.

Engineering Thermodynamics, by James B. Jones and George A. Hawkins. Cloth. 6 x 9¼ in. xviii+724 pages. Illustrated and indexed. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $8.50.

According to the authors, a first course in the subject of classical thermodynamics should give abundant explanations and illustrations of the fundamentals, and in the early part of the book there is a special regard for various points that are known to be stumbling blocks for students. The authors point out that this text is intended for use in undergraduate engineering courses in thermodynamics and its purpose is to help develop in the student (1) an understanding of the first law, the second law, and some physical property relationship and (2) some competence in the application of these principles to engineering systems. The terminology used is that of modern workers in the field, and more than 700 problems covering a wide range of difficulty are included.

Engineers Handbook. Paper 2⅝ x 5½ in. 192 pages. Illustrated and indexed. Published by Ottenheimer Publishers, Inc., 4805 Nelson Ave., Baltimore 15, Md. 90¢.

This engineers' vest-pocket book contains 250 main items, under 12 marginal headings: Mathematics; building; mechanics; heat; hydraulics; piping; electricity; surveying; costs; mining; chemistry; and miscellaneous data. Also included are 47 charts, as well as an alphabetical index, and an index of the charts and tables.

Bibliography Relating to Vibratory Cutting, Penetration and Compaction of Soils, by S. C. Cowin, R. L. Kondner, and R. S. Ayre. 41 pages. No. PB161123. $1.25. *Supplement 1.* 39 pages. No. PB 161124. $1.00. Both are available from the Office of Technical Services, U.S. Department of Commerce, Washington 25, D. C.

An Army bibliography and supplement, these books review literature in soil mechanics, soil physics, engineering, geology and agriculture relating to vibratory cutting, compaction and penetration of soils, plus such related topics as vibrated concrete, vehicle mobility and application of ultrasonic vibration. The basic bibliography contains 212 references; most have summaries. The supplement has 165 references.

Rural Electrification in the United States. Available from Edison Electric Institute, 750 Third Ave., New York 17, N. Y., as EEI Publication No. 59-191. 90¢ each. Quantity prices on request.

This book was prepared by the EEI Committee on Rural Electrification under the chairmanship of W. W. Lynch, Texas Power and Light Co. It presents the history of the growth of rural electrification in this country in a factual, non-controversial and readable manner.

Glossary of Terms for Fluid Power, Second Edition. National Fluid Power Association, 5595 N. Hollywood Ave., Milwaukee 17, Wis. $1.00. Quantity discounts quoted upon request.

This edition, prepared by the Terminology Committee of the NFPA Technical Board, is the second step in the preparation of a comprehensive glossary of terms and definitions for fluid power. It covers 389 terms that have been carefully considered, reviewed and defined by the committee.

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PERSONNEL SERVICE BULLETIN

PERSONNEL SERVICE BULLETIN

Note: In this bulletin the following listings current and previously reported are not repeated in detail. For further information, see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this bulletin, request form for Personnel Service listing.

Positions Open—April—O-126-617. **May**—O-171-619, 187-620. **July**—O-237-622, 245-623, 256-624. **August**—O-270-625. **September**—O-271-626, 303-627, 303-628, 303-629, 303-630, 273-631, 284-632, 306-633, 309-634.

Positions Wanted – April – W-96-26, 110-27, 127-28, 12-29, 117-31, 120-32, 121-33. **May**—W-101-34, 140-35, 129-36, 156-38, 175-39, 119-40, 158-41, 103-44. **June**—W-207-47, 208-48, 199-49, 193-50. **July**—W-221-53, 238-54, 247-55, 252-57, 253-58, 254-59, 257-60. **August**—W-263-61, 264-62, 265-63. **September**—W-274-65, 281-66, 282-67, 283-68, 291-69, 294-70, 278-71, 287-73, 297-74, 300-75.

NEW POSITIONS OPEN

Plant Superintendent, to supervise all manufacturing operations in established company making automatic poultry raising equipment, and some other farm equipment items. Midwest location. Age, up to 35. Experience in supervision and personnel management, sheet metal fabrication, machinery operations, mechanical and electrical assemblies. Good health and appearance. Very good opportunity with growing business. Salary open. O-318-636

Assistant Agricultural Engineer, for extension work in electric power and processing in a southeastern state. BS and MS degrees in agricultural engineering. Some experience in extension or related work. Able to work with people. Excellent opportunity for good worker and cooperator. Salary open. O-320-637

Agricultural Engineer for senior project engineering position on loaders with growing manufacturer of farm and industrial equipment in upper Midwest. Age 25-40. BSAE or BSME. Experience in loader design and development preferred but 3 to 5 years design and supervisory experience on development of other farm or industrial equipment would be acceptable. Interest in agriculture. Willing and able to accept responsibility for engineering success of a group of products. Good opportunities for advancement in engineering, or into other phases of company activities. Inquiries handled on confidential basis with no obligation on part of the applicant. Salary open. O-322-638

Agricultural Engineer for senior project engineering position on haying equipment with growing manufacturer in upper Midwest. Age 25-40. BSAE or BSME. Experience in haying equipment design and development preferred, but 3 to 5 years of design and supervisory experience on other farm or industrial equipment acceptable. Interest in agriculture. Willing and able to accept responsibility for engineering success of a group of products. Good opportunities for advancement in engineering or into other phases of company activities. Inquiries handled confidentially and without obligation. Salary open. O-322-639

Agricultural Engineer for project engineer assignment on design and development of manure spreaders, with growing manufacturer in upper Midwest. Age 25-35. BSAE or BSME. Experience in spreader design and development preferred, but one to three years design experience in other lines acceptable. Desire and ability to handle all phases of a development project from planning to production. Good opportunities for advancement in engineering or other company activities. Inquiries handled confidentially and without obligation. Salary open. O-322-640

Design and Test Engineer for work on electrical and gasoline-powered golf cars, heavy-duty turf equipment, etc., with leading manufacturer. Midwest location. BSAE, BSME, or BSEE. Prefer some experience in mechanical equipment design and development and some background in electrical engineering. Usual personal qualifications for commercial engineering. Excellent opportunity for advancement. Salary open. O-324-641

Agricultural Engineer (assistant professor) for extension work in power and machinery in a large eastern state. Age 25-30. BS and MSAE. Ability and desire to work with people and organizations. Excellent opportunity for productive worker. Retirement system, social security, state health insurance, and sabbatical leave privilege. Salary open. O-325-642

Agricultural Engineer for teaching and research in soil and water field in a southeastern state university. Will head research program in this field. PhD in agricultural or civil engineering. Experience in teaching, research, or other engineering work. Interest in public service work. Excellent opportunity to develop a research program. Excellent retirement system. Liberal vacation and sick leave policy. Salary open. O-326-643

Agricultural Engineer for farm structures research in a land grant college in the Southeast. Will participate in well-established project on structural aspects of farm buildings, including work with full-scale buildings and building sections. Age 22-30. BS degree in agricultural, civil or architectural engineering. Structural design, construction, and/or research experience desirable but not required. Industrious man with integrity, willing to assume responsibility, and able to contribute to harmony on a research team. Employment policy will permit work on advanced degree while fully employed. Excellent opportunity to gain research experience on a nationally recognized project, and to advance professionally. Position available immediately to qualified applicant. Salary $5,400 first year, with provision for increase and vacation. O-341-644

Agricultural Engineers (2) for produce engineering work with growing midwestern manufacturer of farm equipment. Age 27-40. BSAE or BSME preferred. Design and development experience 5 or more years, preferably on harvesting machinery. Usual personal qualifications for engineering in industry. Excellent opportunity in growing department. Salary open. O-347-645

NEW POSITIONS WANTED

Agricultural Engineer for design and development in power and machinery with manufacturer in Midwest or West. Married. Age 39. No disability. BS, 1951, University of Wisconsin. Military service nearly 3 years. Design experience on farm equipment from 1954 to date. Available on reasonable notice. Salary $575 per month. W-305-76

Agricultural Engineer for work in farm structures or soil and water field with consultant. Any location. Married. Age 24. No disability. BSAE, 1958, University of Missouri. Commissioned service in Navy to be completed June 1961. Work experience in administration and as engineering officer on diesel electric destroyer escort. Includes responsibility for entire engineering plant and up to 60 men, with broad exposure to technical material, correspondence, contracts, and specifications. Summer work experience on farm and in manufacturing concern while in college. Available July 1961. Salary $6,000. W-314-77

Training, Public Relations and Management Development Man for management training and development work with industry, any location. Married. Age 42. No disability. BA, 1941, University of Mississippi. MA, 1948, University of Nebraska, in liberal arts and business administration. Additional graduate work at Columbia in liberal arts and labor relations. Commissioned experience in Navy, 8 years in personnel, training and administration of training schools. Industrial experience 3 years as training specialist; 2 years as education and training coordinator, including research, preparation, development, conference presentation and followup on management and non-management training needs. This involved giving instruction in labor relations, human relations, cost control and reduction, work standards, and work sampling. Available on reasonable notice. Salary $850 per month in U.S.A. W-323-78

Agricultural Engineer for sales and service in farm structures or electric power and processing field with industry in Northeast. Married. Age 24. No disability. BSAE, 1959, Cornell University. MSAE expected December 1960, Michigan State University. Research assistant in farm electrification laboratory 3½ years while undergraduate. Graduate assistant one year. Farm work 5 summers. Available January 1961. Salary open. W-328-79

For further information concerning listing below, write to the American Society of Agricultural Engineers, St. Joseph, Mich. Be sure to specify the listing number when you inquire.

SALESMAN WANTED

Experienced in heavy farm equipment, to sell components to farm equipment manufacturers nationally. Excellent pay and future with AAA-1 company. Must be willing to travel and relocate Middle Atlantic area. All replies confidential. Send resume. Reply No. 101-0.

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Aronovici, Vladimir S. — Sr. soil scientist, Western Soil and Water Management Res. Branch, (ARS) USDA, P.O. Box 629, Pomona, Calif.

Bryan, Robert L. — Soil scientist, (SCS) USDA, 318 Hubbard Bldg., Pontiac, Mich.

Bryson, Clyde P. — Asst. agr. engr., Mississippi Agr. Ext. Service, State College, Miss.

Carter, James D. — Dist. rep., Fleco Corp. (Mail) 4243 Irvington Ave., Jacksonville 10, Fla.

Ertugrul, Hursit — Asst., University of Ataturk, Erzurum, Turkey

Freitag, Dean R. — Chief, mobility section, Army Mobility Res. Center, U. S. Army Engineer Waterways Experiment Sta. (Mail) 303 John Allen St., Vicksburg, Miss.

Gladden, William P. — Asst. ext. agr. engr., South Carolina Ext. Service, Poole Agr. Center, Clemson, S. C.

Hall, Anthony B. — Res. asst., University of Toronto. (Mail) 105 Isabella St., No. 309, Toronto 5, Canada

Joseph, A. P. — Soil conserv. officer, Soil Conservation Service, Government of India, P.O. Jogbani, Dist. Purnea, Bihar, India

Laudenschlager, Lloyd G. — Sales engr., concrete products div., American-Marietta Co. (Mail) 4126 Westbury Dr., Fort Wayne, Ind.

Miller, Dalton L. — Assoc. ext. agr. engr., Mississippi State University. (Mail) Box 1535, State College, Miss.

Phillips, Richard E. — Test engr., International Harvester Co. (Mail) 18 E. Benton Ave., Naperville, Ill.

Willson, George B. — Asst. prof. of agr. eng., University of Wyoming. (Mail) 1118 Canby, Laramie, Wyo.

Yeomans, Alfred H.—Mechanical engr., Pesticide Chemical Res. Branch, (ENTRD) (ARS), USDA. (Mail) 3324 19th St., N.W., Washington 10, D. C.

TRANSFER OF MEMBERSHIP

Hodgell, Murlin R. — Assoc. prof., Kansas State University, Seaton Hall, Manhattan, Kans. (Associate Member to Member)

Koch, Kenneth A. — Assoc. spec., Agr. Ext. Service, Knapp Hall, University Station, Baton Rouge, La. (Associate Member to Member)

Reece, Floyd N. — Ext. agr. engr., Kansas State University, Manhattan, Kans. (Associate Member to Member)

STUDENT MEMBER TRANSFERS

Bergsrud, Frederick G. — (University of Minnesota) Field rep., Structural Clay Products Institute. (Mail) 120½ Welch Ave., Ames, Iowa

Soil Compaction Bibliography

An Annotated Bibliography on Soil Compaction consisting of over 600 references with a short description of each reference and complete with subject index has been published by the American Society of Agricultural Engineers. The publication is a contribution of the Bibliography Subcommittee of the Soil Compaction Committee of ASAE, with representation from the Soil Science Society of America. Copies are available at $1.50 each ($1.00 to ASAE members). Quantity price for 25 copies or more is $1.00 each. Orders with remittance may be sent to ASAE, 420 Main St., St. Joseph, Mich.

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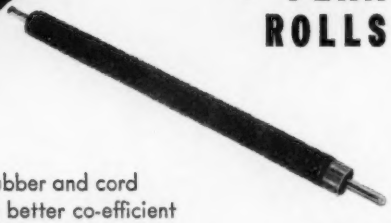

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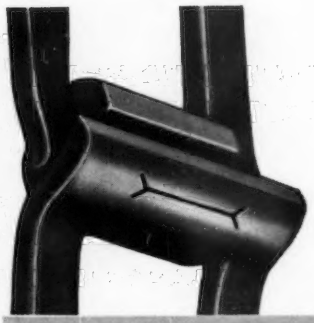

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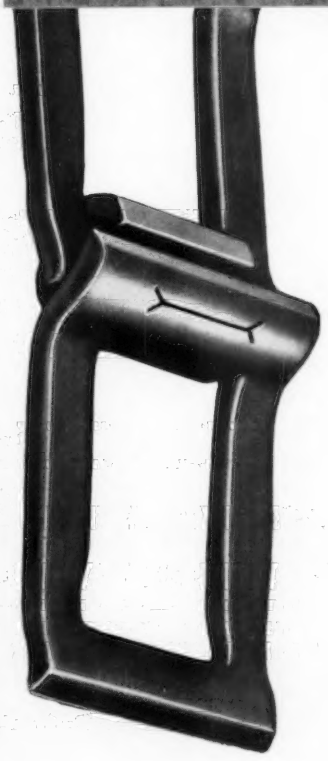

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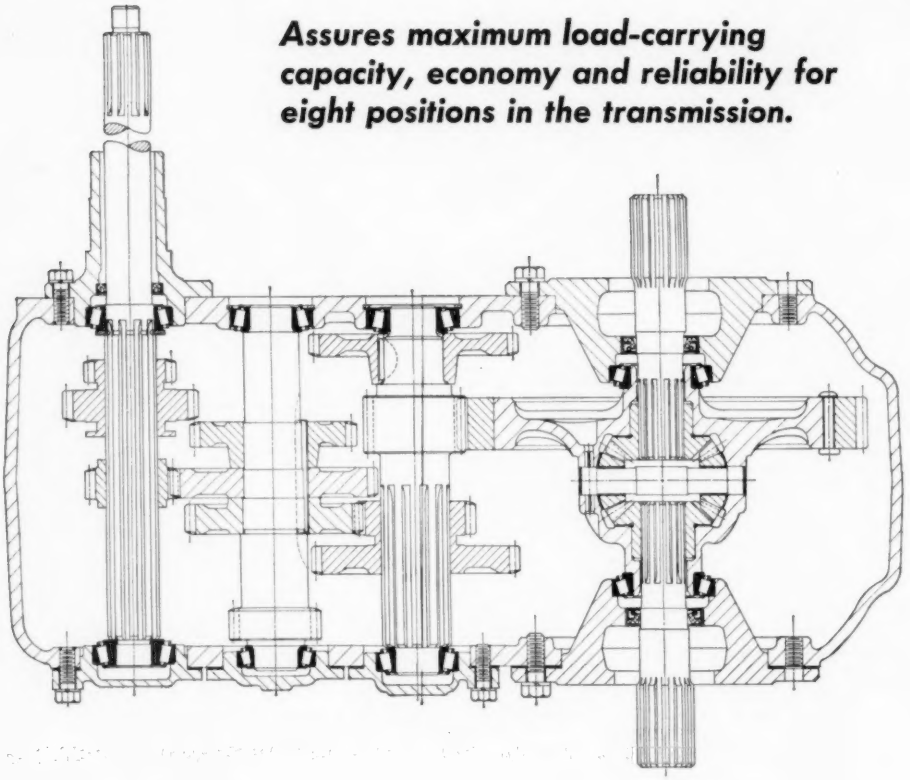

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